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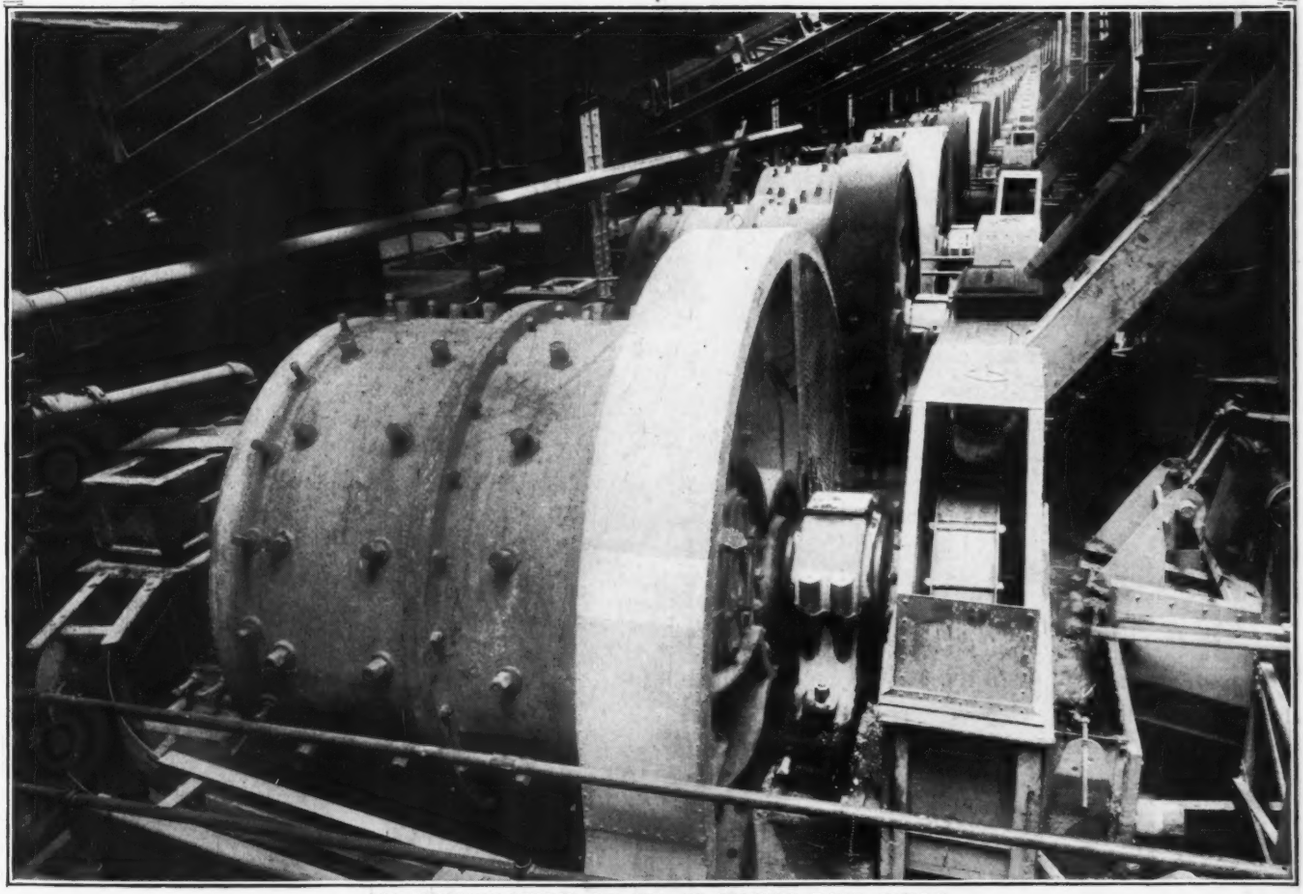

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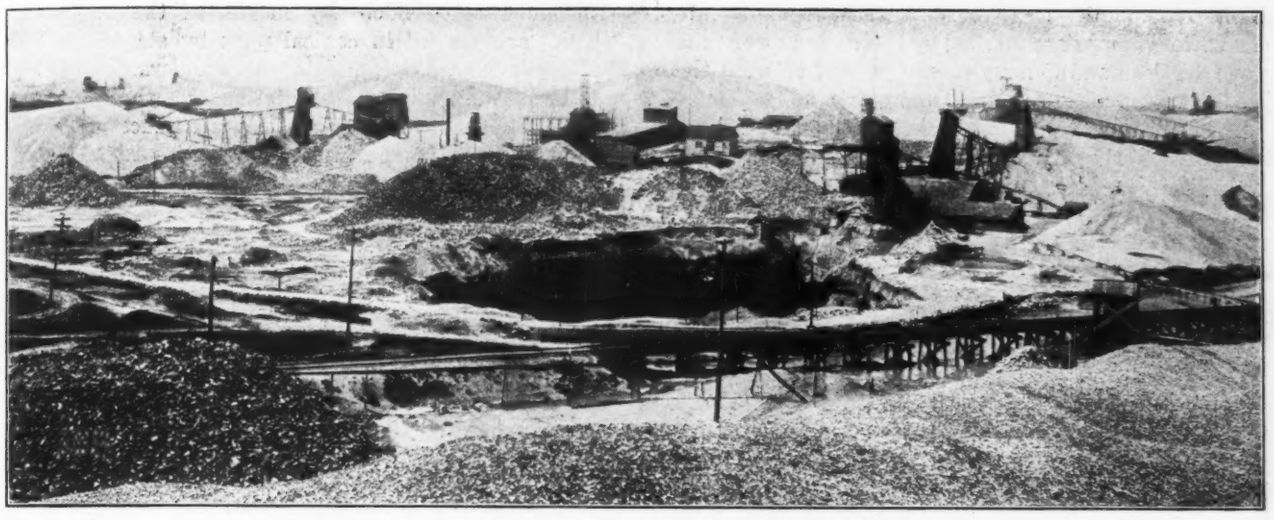
Engineering and Mining Journal

February 23, 1918

Volume 105 *Number* 8



TYPICAL VIEW IN THE SHEET-GROUND AREA, SHOWING EFFECT OF A CAVE

The Mining Districts of Joplin and Southeast Missouri—II

By H. W. KITSON

The mines of the Joplin district lie in an area of 3000 square miles covering parts of southwest Missouri, Oklahoma and Kansas. Most of the operations are on leased units of 20- and 40-acre tracts, although several large companies hold thousands of acres in fee. The ores are mainly productive in zinc blend; galena, however, forms an important byproduct and calamine is obtained in minor quantities. The orebodies occur in nearly level sheets at certain horizons in Mississippian limestone, and are mined from vertical shafts by pillar and open-stope methods. Production is steadily increasing, and new areas are opening up rapidly in the Oklahoma and Kansas sections where the orebodies are high in grade.

THE Joplin district covers a territory of 3000 square miles that includes parts of Missouri, Oklahoma and Kansas, and consists of numerous scattered camps and groups of camps situated along more or less well-defined belts, shown by dark areas on the map in Fig. 1. The main productive section in Missouri lies in Jasper and Newton counties; but the district extends also into Lawrence, Dade, Christian and Greene counties, all of which are in the southwestern part of the state, whence the name Southwest Missouri zinc district by which it is also known. Eastward from the city of Joplin the Missouri section extends to Springfield, a distance of 60 miles, and westward to the Kansas state line. North of Joplin the active camps take in Webb City, Carterville, Oronogo, Waco, Neck City and Alba, and to the south Granby, Spurgeon, Spring City and Saginaw, making a width of 30 miles on a line northward from Granby through Duenweg to Neck City.

In Oklahoma, the Joplin district lies entirely within Ottowa County, in the northeast corner of the state, extending from the vicinity of Miami, 40 miles west of Joplin, to the Kansas state line on the north, taking in Commerce, Quapaw, Sunnyside, Douthat, St. Louis, Century, Tar River, Cardin and Picher. The Kansas section lies in the southeastern part of Cherokee County, and, together with the Oklahoma section, is sometimes called the Miami district. The important communities in the Kansas section are Galena, Treece and Baxter Springs. The main line of the St. Louis and San Francisco R.R. passes through Miami, Baxter Springs, Galena, Joplin, Carthage and Springfield; and the Missouri Pacific, Kansas City Southern, Missouri, Oklahoma & Galena, and Missouri, Kansas and Texas railways connect most of the other camps with Joplin and smelting centers. This city is therefore an important distributing point and an industrial as well as geographical cen-

ter for the entire district; and with the Southwest Missouri Ry. inter-urban electric lines connecting Galena, Webb City, Carterville, Oronogo, Neck City, Carthage and Duenweg, and a population of nearly 50,000, mine workers are able to commute to the various mines and live comfortably in the larger communities.

The panoramic view from the top of any of the innumerable "chat" or tailings piles around Joplin presents the appearance on all sides of a wide level plain, and mining communities can be observed for many miles. The various camps are marked by their mounds of "chat" piles, derricks and dummy elevators, and between them are to be seen cultivated fields and patches of woods.

The country is somewhat broken by the drainage system of the Spring River from its source west of Springfield along its westward course north of Joplin and between Joplin and Baxter Springs, where the surface has a gently rolling relief. The Spring and Neosho Rivers join a short distance southeast of Miami, this district lying mostly between the angular convergence of the two, and having a topography similar to that of Joplin, level and unbroken except for one or two low hills, as at Blue Mound, in Kansas, near the state line north of Picher. The region is on the western border of the Ozark Uplift, and elevations range from 1000 ft. at Miami and Joplin to 1250 ft. and more in the eastern district.

The surface conditions of the district offer great facilities for railway construction and highways, although the rapidly growing amount of traffic over the latter has outpaced the rate of upkeep, and the roads are consequently in poor condition. The proposed concrete county road from Joplin to the new Miami fields is therefore a much-needed project. Railroad spurs have recently been extended to Picher, St. Louis and other camps in the Oklahoma district; and in the near future the important producing centers of this district will all be connected to the main lines of one or more of the important railroad systems. On the other hand the extreme flatness of the country offers no opportunity for favorable millsites and consequently mills are all equipped with elevators inside, and "dummy elevators" with launders outside. By means of the latter the "chats" are heaped in conical piles by stages, and at the larger plants accumulate to considerable heights.

Each of the many small mills that dot the landscape is situated over a hoisting shaft, and surface or underground haulage from adjacent properties to a central

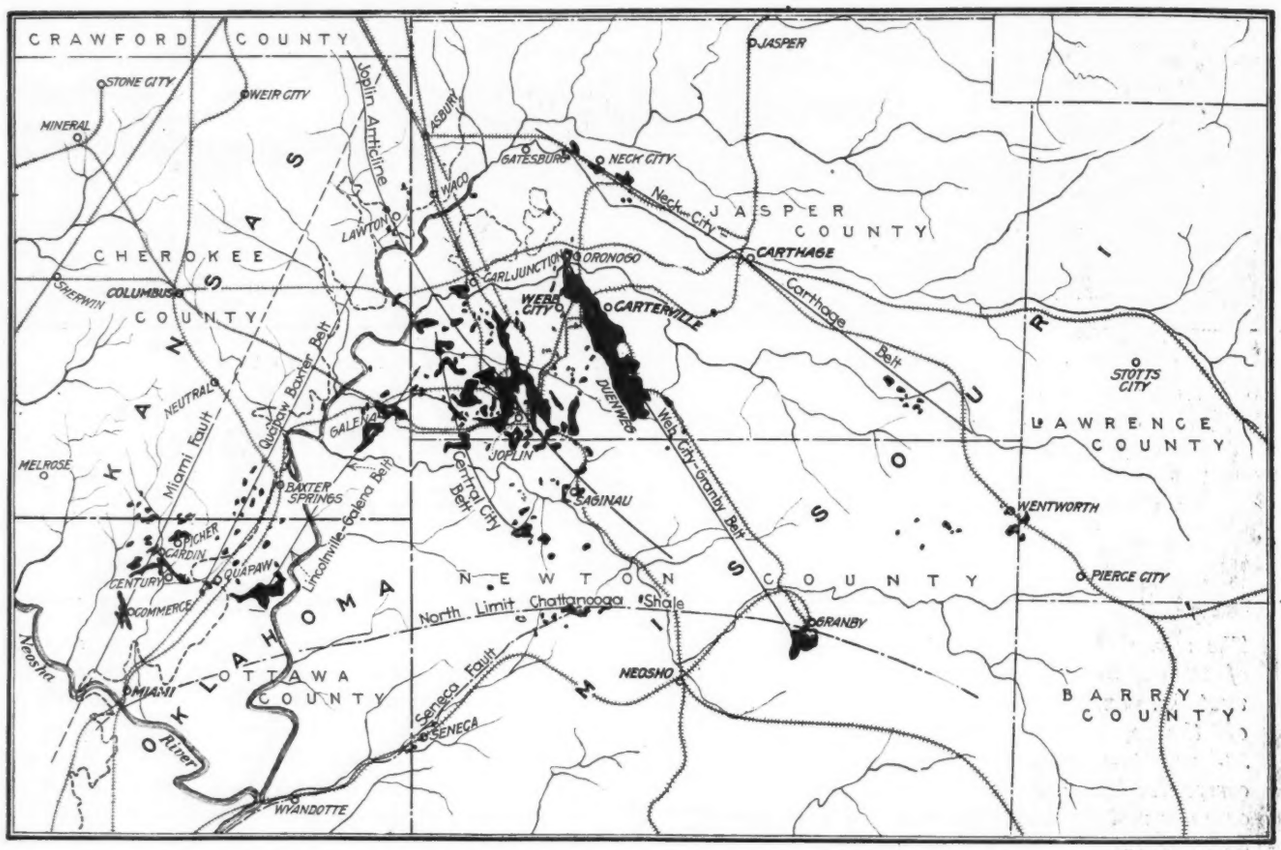


FIG. 1. MAP SHOWING MINED AREAS IN THE JOPLIN DISTRICT, MISSOURI, OKLAHOMA AND KANSAS

mill is rare. The prevailing hoisting practice of the district is by means of buckets, which system enables a light winding engine to be installed at the top of the headframe or "derrick," as it is more properly called. With flat surface conditions this light type of structure has the advantage of giving considerable hoisting height at a low initial cost, which condition is desirable for proper dumping headroom over mill bins or "hoppers" that are most conveniently and customarily built as an integral part of both derrick and mill. Some of the larger and more recent properties, however, are using skips and centralizing hoisting and milling operations. Such practice, however, is only practicable where the operators are not obliged to pay separate royalties to a number of different lessors from the sale of concentrates of ores from an equal number of different five to 40-acre tracts.

In the Missouri and Kansas sections the average unit

of operations is 20 acres and in Oklahoma 40 acres. The reason for this is that most of the mines are worked under a leasing system. Mining rights are leased on land owned in small tracts by the decendents of the original settlers of Missouri and Kansas, who were altogether an agricultural people, and by the Indians in Oklahoma who own their land in tracts granted by the Government.[1] Many of the larger companies have purchased considerable tracts of land outright and some have purchased the right to mine without royalty, but do not possess the surface rights. The large number of small independent operators obtain leases usually for 10 years and pay royalties on shipments of ore at rates ranging from 2½ to 25%, the average being about 7½% in the Oronogo-Duenweg sheet-ground pillars underground or in the tailings on top. The wisdom of such policy from a commercial standpoint is evident. More elaborate methods have been attempted, but they proved commercial failures. Exact data on mine and mill extractions in the district are, in the nature of the methods used, almost impossible to obtain. It is estimated, however, that from 10 to 15% of the orebodies remains in pillars and that from 58 to 70% is recovered in the mills.

Leases usually provide for the removal by the lessee of all machinery and equipment at the expiration of his lease, and as the standard practice of the district in both mining and milling is adaptable in all mines it enables an operator to salvage and transport the machinery of his mill, hoisting and other equipment almost

PRODUCING COMPANIES OF THE JOPLIN DISTRICT

MISSOURI

Joplin

	Blende	Galena
Bumble Bee M. Co.	242,140	.....
St. Regis M. Co.	264,830	.....
Little Martha M. Co.	149,150	.....
Fifteenth Street M. Co.	171,300	.....
Gibson M. Co.	120,800	.....
Consolidated-Inter-State M. Co.	83,410	.....
Swartz M. Co.	92,290	.....
Malcona M. Co.	65,450	.....
Ethel Gray M. Co.	62,270	.....
New Geronimo M. Co.	63,100	.....
Eaglewood M. Co.	55,370	.....
Wise Guy M. Co.	40,270	.....
Paragon M. Co.	62,700	.....
Malsbury M. Co.	25,480	.....
Rabbits Foot M. Co.	7,690	.....
Sundries	241,610	241,210
Totals	1,747,860	241,210
	Calamine	
Falkner M. Co.	63,800	.....

Webb City—Carterville

	Blende	Galena
Bertha A. M. Co.	510,730	.....
American Z. L. & S.	458,660	.....
Kirkwood M. Co.	161,150	.....
Queen Esther M. Co.	170,280	.....
Concord M. Co.	156,140	.....
Unity M. Co.	86,190	.....
Ben Franklin M. Co.	72,280	.....
Mahatmah M. Co.	65,820	.....
Nearby M. Co.	47,510	.....
Lucy Bell M. Co.	35,690	.....
Shawgo M. Co.	13,230	.....
Sundries	309,340	220,710
Totals	2,087,020	220,710

Duenweg

	Blende	Galena
Athletic M. Co.	803,790	.....
Coahuila M. Co.	545,050	.....
St. Regis M. Co.	206,180	.....
What Cheer M. Co.	65,660	.....
Total	1,620,680	.....

Oronogo

	Blende	Galena
Mutual M. Co.	227,680	175,300
Oronogo Circle	192,000	.....
Totals	419,680	175,300

Aurora

	Blende	Galena
Red Wasp M. Co.	178,000	.....
Bonanza M. Co.	159,800	.....
Mills & Co.	62,180	.....
Murray & Co.	12,660	.....
Total	412,640	.....
	Calamine	
M. A. & F. R. Co.	80,000	.....
Mathews-Phelps M. Co.	70,000	.....
Sandridge M. Co.	44,240	.....
Consolidated M. Co.	34,000	.....
Total	228,240	.....

Granby

	Blende	Galena
American Z. L. & S.	66,800	.....
	Calamine	
Perkins M. Co.	1,400,000	.....
J. R. Underwood M. Co.	80,000	.....
Woodcock M. Co.	80,000	.....
Buick M. Co.	70,000	.....
Total	1,630,000	.....

Belville

	Blende	Galena
Tennessee M. Co.	130,800	.....
Culbert L. & Z. Co.	45,940	.....
Kirkpatrick M. Co.	19,330	.....
Total	196,070	.....

Alba-Neck City-Purcell

	Blende	Galena
Joplin Concentrating	67,000	.....
Sponable M. Co.	66,460	.....
Total	133,460	.....

KANSAS

Galena

	Blende	Galena
Diplomat M. Co.	130,730	.....
South Side M. Co.	87,000	17,610
Andrew Bros. M. Co.	85,510	.....
Way and M. Co.	87,520	106,010
C. W. Squires M. Co.	72,000	.....
Boor M. Co.	48,510	.....
Brenz M. Co.	9,990	.....
Galena L. & Z. Co.	.....	3,040
Sundries	.....	116,660
Totals	521,260	243,320

Waco-Lawton

	Blende	Galena
Eastern L. & Z. Co.	360,160	.....
Smart & Crane M. Co.	254,540	.....
Total	614,700	.....

OKLAHOMA

	Blende	Galena
Picher Mines	2,630,400	.....
Underwriters Land Co.	936,850	.....
Mahutska M. Co.	820,470	.....
Montreal M. Co.	659,740	.....
U. S. Smelting Co.	600,000	.....
Bilharz M. Co.	398,240	.....
Admiralty Zinc Co.	322,290	.....
Skelton No. 2	300,040	.....
Anna Beaver M. Co.	281,600	.....
Bethel M. Co.	278,840	.....
Ramage M. Co.	191,130	.....
Metals M. Co.	130,000	.....
C. Dawson, trustee	122,560	.....
Skelton No. 1	87,890	.....
Lucky Kid M. Co.	85,350	80,880
Central L. & Z. Co.	117,540	.....
Lion M. Co.	115,690	.....
Piokee L. & Z. Co.	83,960	.....
Lucky Bill M. Co.	80,000	.....
Dewdrop M. Co.	87,080	.....
Haynes M. Co.	78,970	2,860
Woodchuck M. Co.	54,360	.....
Croesus M. Co.	.....	85,960
Blue Goose M. Co.	.....	65,440
Sundries	.....	243,220
Totals	8,463,000	478,360

Total production for the week ended Oct. 20, 1917, was: Blende, 16,283,170 lb.; calamine, 1,922,040 lb.; lead, 1,358,900 lb.

mines, which are the lowest of all in grade. Since the boom in the newer fields north of Miami premiums are asked in addition when the leases are taken, and royalties average from 10 to 15%. Some of these premiums have run as high as $260,000 on the larger tracts. When a lease is solicited, a one-year's option for drilling and proving up the ground is given, subject to acceptance by the lessor at the end of that time, together with the previously drawn up terms of lease.

Individual orebodies are of varying size, but the range of life is from six months to six years. Under such conditions it is apparent that little capital can be put into plant and development, and the result has been methods both in mining and milling that will yield a marketable product at the lowest possible combined cost of plant and operation, with little regard for loss in intact to another part of the district and continue operations on a new tract under a new lease.

Ores and concentrates are sold at the mills through ore-buying agencies representing the various smelters, according to the time-honored custom of the district, at so much per dry ton. For zinc sulphides the base price per ton is quoted by the buyers for a 60% zinc metal content and is subject to fluctuation according to the market price for spelter and special characteristics of individual ores. Concentrates of higher or lower grade than 60% are respectively allowed or penalized $1 for each unit above or below this base. An iron content of 1% is accepted, but above this amount a penalty of $1 per unit is imposed. The maximum allowable lead content in zinc concentrates is fixed at 0.3%, and amounts over this are penalized indirectly in calculating base-price quotations. Zinc silicate ores are sold on a base price for 40% zinc metal, with premiums and

[1] "The Mining Districts of Joplin and Southeast Missouri—I." "Engineering and Mining Journal," Dec. 22, 1917.

penalties corresponding to those established for sulphides. Concentrates of lead sulphide are bought in a similar manner, quotations being fixed on a base of 80% lead metal, with the same rate of premium or penalty per unit above or below 80% as for zinc. There are, however, no penalties or premiums for zinc or iron.

In the Joplin district grades of ore mined are considered in terms of base grade concentrates made. Thus a 2% ore is understood to mean one from which 100 tons would produce at the mill 2 tons of combined concentrate of the base grades given. Zinc concentrates vary in grade in different parts of the district from 50 to 65% metal, and lead concentrates from 70 to 83% metal.

Separate description of the many independent operations in the Joplin district is not necessary, as their number is great and the difference slight; but reference to the holdings of some of the larger companies is of interest. The American Zinc, Lead and Smelting Co. holds in fee thousands of acres in groups located north of Joplin, Webb City, Carterville and Oronogo, and south of Joplin in small scattered tracts extending from the Oklahoma line to Granby and including the properties absorbed in 1916 of the Granby Mining and Smelting Co., and recent acquisitions along the western border of present activities in the Kansas field. In the Oklahoma section the most important producer is the Eagle-Picher Lead Co., with rich and extensive tracts leased and sub-leased at Picher, Cardin and south of Tar River.

The Miami Zinc Syndicate has leases aggregating 4000 acres in tracts under development west of Baxter Springs in Kansas; and the American Metal Co. has a vast number of small tracts in the northwestern part of the Missouri section and extending from northeast to southwest across the Kansas section along the so-called Miami fault belt. The properties of the Commerce Mining and Royalty Co. lie mostly in the Miami field to the west of Miami, Century and Picher, extending along the Miami fault belt into the southern part of Kansas. This company was the first in the western fields, having struck ore at Commerce in 1905. The Vinegar Hill Zinc Co. has a comparatively smaller tract west of Baxter Springs and west of the Commerce company's properties, and the U. S. Smelting Co. has developed and completed a large mill on tracts west of the Vinegar Hill ground, and holds some leases northeast of Waco. Other large development enterprises in the district are: The Chanute Spelter Co., with 16,000 acres; the Butte and Superior; the Waco Mining Co., with 7100 acres; P. B. Butler, with 6500 acres; the Danglade, and the Church & Mabon interests. The most important producers at present are those given in the table, grouped according to their respective camps and showing the relative production in various classes of ores and concentrates as officially reported for the week ended Oct. 20, 1917. The base range of prices for ores and concentrates for the week was: Blende, from $60 to $75, with an average of $67.50 and an average settlement price of $66. Galena was sold in prices ranging from $70 to $80 per ton and calamine $35 to $38 per ton.

Zinc silicate ores are mined in certain parts of the district, as at Granby, Duenweg and Joplin City. Granby is the chief producer, and in 1916 averaged about 50 tons per day. The American Zinc, Lead and Smelting Co. is at present producing from its own and sub-leased properties in Granby about 40 tons of this ore per day. But little lead-oxide ore is found. The average rate of production in silicate ores from all camps is about 75 tons per day.

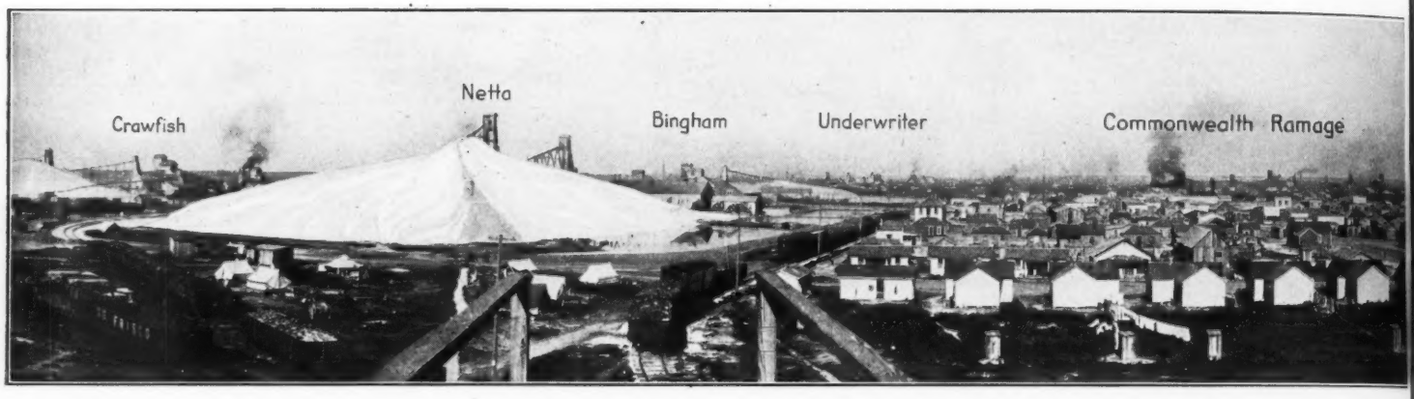


FIG. 2. PANORAMIC VIEW OF PICHER, OKLA., SHOWING THE MOST ADVANCED

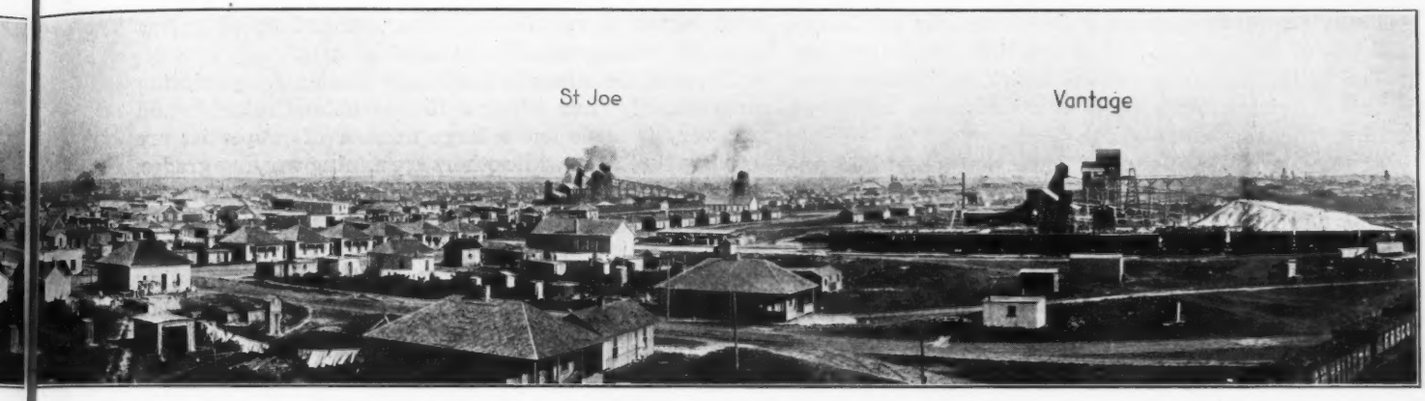
According to the annual statistics published by the *Journal*, the production in ores and concentrates of the Joplin district in 1917 was 550,000 tons. Of this amount 80% was blende, 6.5% calamine, 13.5% galena. Missouri produced 58.5% of the total tonnage, Oklahoma 34% and Kansas 7.5%. Considering the proportional production of total blende ores, which was 442,000 tons, Missouri accounted for 56%, Oklahoma 36% and Kansas 8%. Most of the calamine came from Missouri mines and amounted to 35,695 tons, Oklahoma producing only 65 tons and Kansas none. Of the lead ores produced, which altogether amounted to 72,500 tons, Missouri yielded 55%, Oklahoma 39%, and Kansas 6%.

Joplin Zinc Production Showed Steady Increase

In each of the four years since 1913 production from the Joplin district responded to advancing prices of zinc; and although in 1917 zinc concentrates averaged only $67.70 per ton with zinc at 8.7c. per lb., as compared to $84.72 in 1916 with zinc at 12.5c. and $79.30 per ton in 1915, when zinc was 13c. per lb., Joplin increased its production nearly 26% over that of 1916. The annual increase over the preceding year in 1916 was 23% and in 1915, 12%. Considering the production in 1914 as normal compared with previous years since 1900, when prices of zinc concentrates ranged between $40

and $45 per ton and spelter between 5 and 6c. per lb., the production of 1917 was 60% greater than in normal pre-war years. Lead ores reached the highest average basic price in 1917, which, roughly, was $98 per ton, as compared with $84 in 1916, $55 in 1915, $46.50 in 1914 and $52.50 in 1913. Although an important byproduct of the Joplin district, lead is produced in comparatively small quantities, and the fluctuations of the price of zinc practically govern operating conditions, irrespective of the price of lead.

The response to the demands of the war, reflected in the increased prices of zinc and lead, was made possible by the exploration of lower-grade ores in the Missouri sheet-ground mines and the rapid expansion of developments in the Oklahoma and Kansas high-grade fields. The last six months of 1917 witnessed a strong reaction in metal and concentrate prices, and many mills operating on low-grade sheet-ground ores were forced to cease operations. A large percentage were dismantled and taken to the newer fields. As a consequence, this condition decreased the 1917 production of blende from Missouri about 9%. The production of lead and calamine was slightly increased. In Oklahoma and Kansas many developments started in 1915 and 1916 reached their productive stages early in 1917, and notwithstanding the drop in metal prices later in the year, this section of the district continued its intensive production and was only prevented from making greater gains by shortages of labor and power. The increase in production of blende from Oklahoma and Kansas in 1917 was 175% and of lead 94% of the production of 1916.



OPERATIONS AND THE INTENSITY OF DEVELOPMENT IN A PERIOD OF TWO YEARS

Orebodies Mainly in Mississippian Limestone

The orebodies of Joplin, as mentioned, occur in all Carboniferous sedimentaries of the district, but mainly in the cherty crystalline Boone limestone of Mississippian age. The Boone outcrops throughout all but the extreme western limits of the district, has a total thickness of 350 ft. and a slight regional dip somewhat north of west, disappearing in the Oklahoma and Kansas sections and at the northwest corner of Jasper County, Mo., under the overlying and successively outcropping Chester and Cherokee limestones, sandstones and shales, respectively of Mississippian and Pennsylvanian age. Two distinct classes of orebodies occur in the Missouri section, and locally these are known as the "upper run" and the "sheet-ground" deposits. The "upper run" deposits were the earliest found, occurring near the surface in the higher horizons of the Mississippian limestones, mainly in the bouldery ground along the roughly semi-spherical contact made by the deposits of the later shales in ancient sink holes in the Chester and Boone. The sheet-ground deposits occur in a cherty stratum of the Boone known as the Grand Falls chert, that lies in nearly horizontal position about 250 ft. below the surface and from 50 to 100 ft. from the lower shale base of the Boone formation.

The Grand Falls chert has a thickness varying from eight to 50 ft. The sulphides occur as replacements of the lime and deposits in openings, disseminated in a cherty breccia and laminated in roughly horizontal seams intercalated between alternate narrow bands, or sheets, as the name implies, of chert, flint and jasperoid. The Grand Falls chert is seldom mineralized for more than 20 or 25 ft. vertically, the orebodies being inclosed above and below by barren zones of flint of varying thickness; but these deposits extend over wide areas in many parts of the western portion of the Missouri section, and most typically and persistently in the zone, shown on the accompanying map, between Oronogo and Duenweg. The sheet-ground deposits, although far more extensive and productive than the "upper run" deposits, especially in the present mines, are much lower in grade, yielding in 1916 mill recoveries, in the orebodies then worked, ranging from 1½ to 3% combined sulphides. At present 2% ores are barely yielding a margin of profit.

In many places the sheet-ground orebodies are continuously connected to the sink-hole deposits above by orebodies occurring in the upper Boone. Such orebodies also are replacements and deposits in and upon the limestone walls of former openings or channels. The mineralization has in some places been followed in mining for varying distances below the sheet-ground deposits in what is known as the "second lime." Camps where the mining of "upper run" orebodies still exists are Duenweg, Joplin and Granby. The largest sheet-ground mines are at Webb City, Carterville, Joplin, Duenweg, Porto Rico and Granby. The "lower run" orebodies have been mined at Oronogo, Sarcoxie, Aurora and Cave Springs. At Granby and Springfield ore has been mined from the "gumbo runs" or deposits in the basic shales of the Boone formation.

In the Miami district definite geologic relationships are not so apparent and have not as yet presented sufficient evidence for complete and satisfactory conclusions.

Two distinct ore horizons or "runs," however, are recognized. The "lower run," which to date is the most important both in grade and size of the orebodies, lies at depths ranging from 250 to 300 ft., and in shape, thickness and general dip and strike presents characteristics similar to the sheet-ground deposits of Missouri, without, however, having the sheets of flint characteristic of the Grand Falls chert. In the Miami orebodies the mineralization is considerably higher in grade than in the sheet-ground mines and generally presents more of a disseminated structure. There is more limestone in the gangue of the orebody, and considerable yellow calcite or "tiff"; and although much of the ore occurs in tabular narrow seams, and considerable flint and chert are present, the formation in the mineralized areas so far mined appears to be more extensively of the brecciated and recemented type, and on the whole presents decided marks of distinction from the structural characteristics of the sheet-ground orebodies. The richest ores have been concentrated along bedding planes and parallel watercourses where a sheeted condition exists, and may represent horizons which, according to Siebenthal, are at the terminus of an artesian circulation controlled by the impervious shales which begin to outcrop in this district and mark the ever-increasing radius of erosion from the central dome.

At Commerce a well-defined fault was recognized underground, and fissuring occurs in other parts of the Miami district. Apart from this, however, no well-defined evidence of faulting has yet been found and given general recognition. In fact, the so-called Miami fault shown on the map is arbitrary, and merely represents the general trend of present development. The "upper run" deposits of the Miami district are the shallower orebodies, and these occur from 100 to 150 ft. below the surface, mostly in the Chester limestone, and generally are somewhat lower in grade than the ores mined from the "lower run," and contain a considerable amount of bituminous matter that interferes more or less with concentration.

Ore Deposited from Artesian Circulation

The proportion of lead to zinc in the Joplin sulphide ores varies considerably in different sections of the district, and in each section there is a considerable variation due to relative depths from the surface. If the artesian theory is accepted, the original deposits in the bedding planes and seepage channels would have a primary character varying both in grade and relative lead and zinc content to such deposits as have been either leached or enriched by the later action of surface waters. The primary ores exposed by erosion have been impoverished by the oxidation and solution of the zinc sulphides and relatively enriched by the less soluble residual galena. Part of the zinc taken into solution replaces limestone or combines with silica in solution at or near the surface to form carbonates and silicates in favorable channels, and part migrates in solution to greater depths below the surface, reprecipitating secondary sulphides below the zone of oxidation and thereby producing an enrichment in zinc relative to the lead contained in the primary sulphides. To a much less extent in the Joplin district, owing to the lower solubility of lead, galena has undergone a similar process.

The first orebodies mined in the Joplin district were for the lead content, and for a number of years carbonates of lead only were recognized. As greater depth was attained galena became the predominant ore, but when still deeper zones were reached the relative quantities of blende increased, until at the depths exploited in recent times sphalerite establishes the district as a producer of zinc. Pyrite and marcasite occur as associated minerals in nearly all Joplin ores, but although the percentage of iron sulphides is comparatively small, their relative proportions in ores vary considerably in different localities. The common gangue minerals are dolomite and calcite, deposited contemporaneously from acid solutions with the sulphides, and jasperoid, a metasomatic replacement of silica and limestone which occurs abundantly as a deposit from the same solutions. Excepting in the camps mentioned, most of the mines at present in the Missouri section are producing from the sheet-ground deposits, which are the lowest-grade ores of the district, and but for the large tonnage available could not be made to yield a profit. In the Miami and Kansas sections the ores are uniformly higher in grade and contain a relatively greater percentage of galena than the sheet-ground deposits of Missouri.

Some of the mines in the Picher section are producing ores steadily from which a 15% combined sulphide mill recovery is made and a large number of properties are milling 10% ores, while others are mining varying grades, probably averaging over 5%. The Laclede mine, in the Miami district, recently broke into an open cave the walls of which were solidly lined with cubes of galena, individual crystals ranging up to four inches in size. Such deposits are probably of scientific interest rather than of commercial importance, as the amount of such ore is limited and furthermore presents certain difficulties in handling.

(To be continued)

Economic Aspect of Flotation in Southeast Missouri

The cost of flotation in southeast Missouri is many times that of tabling, and the flotation concentrates are much lower in grade than are the table concentrates, which shows that every effort should be made to minimize the tonnage treated by flotation, according to A. P. Watt.[1] Flotation has many disadvantages; it is no panacea for all the ills of the district. As all the larger companies operate their own smelteries, consideration must be given to the cost of treatment of flotation concentrates by the smelter, together with the high dust loss. What must be considered is the greatest ultimate profit to the company, not the greatest profit to any certain department. Every pound of lead recovered in the mill by gravity methods yields a greater profit to the company than it does if sent to flotation for treatment. Flotation produces a larger tonnage of concentrates than tabling, and the grade is lower. Because of the larger tonnage of low-grade product, the freight and smelting charges are higher for the flotation concentrates. In general it can be said that every pound of lead saved by flotation yields a smaller profit than if kept out of the flotation plant and saved in the mill.

[1] "Concentration Practice in Southeast Missouri," a paper presented at the St. Louis meeting of the American Institute of Mining Engineers, October, 1917.

Use of Powder in Opencut Blasting

By E. S. JACOBSON*

The economical use of powder in opencut blasting is a subject not frequently discussed in print. The author gives some practical suggestions based on the experience of more than 20 years.

IN ANY type of blasting, the placing of holes is of prime importance. In order to get the greatest yardage from a hole, it should be placed as far from the face as possible and at the same time clear the bottom of the bench. Experience indicates that in blasting with a vertical face the holes should be placed 10 in. from the edge of the face for every foot of hole depth. For example, if the hole is 30 ft. deep, deduct 2 in. for every foot, which is equal to 60 in., or 5 ft., leaving 25 ft., which should be the maximum distance between the hole and the edge, consistent with good work. This thickness will vary according to the texture of the rock, but the variation seldom will be more than 20 per cent.

Breakage Area of Holes

Assuming that ground is uniform and has no cleavages, a hole will reach as far to each side as the resistance indicated in front of the hole less 10%. For example, if the hole is 30 ft. deep, then the thickness or resistance is 25 ft. less 10%, which equals 22½ ft. on each side of the hole, or 45 ft. over all. Multiply the length by the width, which gives 1125-sq.ft. area, equal to 125 sq.yd.; multiply this again by 10 yd., the depth of the hole, and the result is 1250 cu.yd. of rock. The amount of black powder necessary to move a cubic yard of solid rock varies considerably and depends principally on the rock. If the rock is brittle use less powder; if tenacious, add a little more. Variations in the specific gravity of the rock also affect the amount of powder needed. Where rock is heavy, more powder must be used than where the rock is light, the variation between the maximum and the minimum being about 30%. The average amount of black powder necessary per cubic yard of rock is ½ pound.

If the springing of a hole should slough off some rock, an estimate should be made of this amount, expressed in cubic yards, and the amount of powder to be used should be reduced to correspond. If, on the other hand, the ground has moved beyond the limits and is going to take in more material behind the hole, an estimate of the amount should be made, as stated above, and powder added to correspond. Likewise, if a weakness of the rock mass be discovered, and it appears that the hole is not going to break the quantity that was at first supposed, calculate the amount of difference and reduce the powder as stated above.

Hold the spring (or pocket) as near to the bottom as possible. A hole requiring 25 kegs of powder should not be allowed to raise more than 3½ ft. above the bottom of the excavation, although 2 ft. is to be preferred. In case the pocket will not hold the stipulated amount within the stated vertical height, reduce the charge in proportion to the feet the charge raises above 3½ ft., by calculating the number of yards lost and deducting the charge at the rate of ½ lb. per cu.yd. lost.

Black powder is not a success when water collects in the pocket after the last spring to a depth of 2 in. in 30 min. or less time. In this case I use dynamite. Experience has been that 45 lb. of 40% dynamite is equal to 100 lb. of black powder. Dynamite, however, does not reach out as far from the hole as the black powder. In fact it often pulls less than half. To overcome this difficulty, it is advisable to shoot two or more holes at once, using electric caps. From the fact that dynamite covers a smaller area it is evident that the placing of holes must be adjusted to correspond. My experience has been that for dynamite 8 in. from the face for every foot in depth is the most economical, subject to variations according to the kind of rock. The distance between holes should be about 6 in. for every foot of depth. For example: A hole 30 ft. deep with a distance from the face of 20 ft. will reach 15 ft. on each side. The second 30-ft. hole will have a reach of 15 ft. to each side, so that the holes in this case should be 30 ft. apart. The area of the two holes is as follows: Thickness, 20 ft.; width of the two holes, 60 ft.; area, 1200 sq.ft. or 133⅓ sq.yd. which, multiplied by 10 yd., the depth of the holes, gives 1333⅓ cu.yd. On an average this will require 300 lb. of dynamite containing 40% nitroglycerine.

Blasting for Steam Shovels

In blasting for steam shovels it is evident that the bottom of the cut must be left level, in which case it is policy to place the vertically drilled holes back to the maximum, as indicated above, and sometimes a little more. As soon as the face is clear to the grade-line, drill a horizontal row of holes, starting them at grade level and dipping downward about 2 ft. in 10; the holes should reach one-half the distance between the toe of the face and the base of the hole. The main holes should always be put down 3 or 4 ft. below grade line in order to avoid, as much as possible, the necessity of blockholing, which is expensive. The toe holes should be placed as far apart as the holes are deep and should be sprung at least once—twice if the rock is hard. It is not advisable to put enough powder in the lifters to break the ground represented over them, but sufficient to crack the rock between the lifters. The amount of powder thus used must be deducted from the charge to be used in the main holes. In this kind of blasting all the holes must be discharged at one time, using electricity.

When blasting in cuts, such as railroads, canals or other narrow places, the spacing of holes is based upon a different principle than that expressed above. For instance, a railroad cut is 18 ft. wide and it is desired to reach both slopes with one hole and not to break ground on the outside because seldom is full compensation paid for the ground taken out beyond the slope stakes and at times no compensation at all for over-breakage. If holes fail to reach the slopes (after a cut is 12 ft. deep), place the hole further back from the face and

*Foreman of rock fill, Pilares mine, Pilares de Nacozari, Sonora, Mex.

drill the holes well below grade line. If the holes overreach, take in less ground in front of the hole. Experience shows that drilling the holes two or three feet below grade line at points 11 or 12 ft. back from the face will give the best results. On an average this class of work will take about 25% more powder than indicated in openpit work.

There are no fixed rules by which one may know exactly the amount of powder a hole will take after it has been sprung, although the following rules will serve as a rough method of procedure: It is policy to keep the pocket as near the bottom as possible. In order to accomplish this, it is best to make the first spring with two or three sticks of powder. After the powder is in the hole, mark the tamping stick at the collar of the hole so you will know in case of a misfire how far you can drill with safety. Cover the first spring with tamping to a depth of 18 in. This is done in order to keep the pocket low and also to avoid ripping the hole above. In the following springs two or more feet of tamping is necessary. When the second spring is made, count carefully the number of sticks it takes to fill the pocket, but do not allow the powder to come above the pocket made by the first spring. If the pocket will contain 21 sticks, divide 21 by the number of sticks in the first spring, which was three in this case. The result, as is apparent, is seven.

Rule for Determining Quantity of Powder Required in Charge

From the above it is learned that the pocket expanded to seven times the size of the charge of dynamite it contained. Thirty-seven sticks of $1\frac{1}{8}$ in. or 48 sticks of $\frac{7}{8}$-in. powder equal one keg of black powder in bulk. If one wishes to put 20 kegs of black powder in a hole of the size above mentioned, multiply 37 (which is equal to one keg) by 20, which is the number of kegs. This shows that the desired result is a pocket that will hold 740 sticks. Dividing 740 by seven shows 105 to be the number of sticks necessary for the last spring. As a rule the last spring will expand the pocket from 15 to 20% more than indicated by the powder used, based on the figures as given above. Therefore, deducting 20% leaves 84 sticks of powder, which 9 times out of 10 will be sufficient. If in the springing of a hole it is apparent that the hole is going to be so badly broken in the last spring that it will not be practicable to load it with black powder, reduce the spring to one-half and load with dynamite.

Precautionary Measures To Be Observed in Blasting

More accidents occur through the non-observance of precautions than from all other sources combined. It is customary to make the first spring with a short fuse, which is done in the following manner: Cut the wrapper lengthwise on one side and drop one stick at a time into the hole. Put down the tamping stick and tamp each stick separately until the required number is in place. If the powder thus far has dropped freely to the bottom, the spring can be made with a drop fuse. Cut the fuse 18 in. long and open one end of a stick of powder (care should be taken not to tear the wrapper). Make a hole in the center large enough to insert the primer and carefully straighten up the wrapper around the fuse. Then tie the wrapper firmly with a cord. Before igniting the fuse be sure to have enough fine dirt to cover the powder to the depth of 18 in. Ignite the fuse and drop the charge in the hole. Do not attempt to follow the charge with tamping stick, which is a common error. In making the second or following springs, it is not practicable to use the drop fuse except in cases where the pocket is full of powder, and then only if the hole is entirely free from all obstructions.

In making preparations to blast with an electric fuse, punch a hole in one end of a stick of powder and insert the primer. On the opposite end make a half hitch and adjust firmly. Now run down the tamping stick until it reaches the powder in the hole. Mark the tamping stick at the collar of the hole. Withdraw and measure the length required for the wires, making a kink in the wire so as not to lose the mark. Now lower the stick of powder by the wires until it reaches the mark, and when it reaches the mark do not follow it with the tamping stick. Where it is necessary to use a tamping stick after putting down the primer, use one that is perfectly smooth and small enough so that it is not necessary to force it down. If there are any slivers on the stick, remove them, because they may pick up the primer, and then when the dirt is put in the primer may get separated from the charge and there will then be no explosion.

Treatment of Choked Holes

If, while pouring black powder into a hole, the hole should choke, do not attempt to drill it out with a steel drill. Use a copper bit, about 1 ft. long, threaded on one end to fit into a $\frac{3}{4}$-in. pipe coupling. If there is time, the following method is better still: When pushing down the tamping stick, if it is found that the hole is choked with powder, do not jar it at all, but calculate the number of feet the powder has raised in the hole and pour in one pint of water for every 3 ft. of hole that has filled with powder and let it stand for one hour and a half. The tamping stick may then be pressed down through. If, after applying the electric current, you fail to get an explosion, do not return at once to ascertain the nature of the difficulty, as explosions are often delayed.

When holes are choked, the most effective way to overcome the danger of missed holes and delayed explosions is not to attempt to pass the primer (or cap) down the hole inserted in a stick of powder, but to use the following method: Make a loop as near the cap as possible, small enough so that the tamping stick will not pass through, but do not use a slip loop; cut the tamping stick to a wedge point and cut out the center of the wedge in a V-shape. Place the loop between the two prongs of the V, holding the fuse firmly in one hand. Then pass the tamping stick to the bottom and press gently downward until the dry powder is encountered. Secure the end of the fuse that is held in the hand. Place both palms of the hands on the tamping stick and roll it back and forth between them, at the same time raising upward gently and using care in removing it. Put in a quart or two of dry powder before filling the hole with dirt. Always remember: If there are two or more holes in circuit there may be an explosion the instant the current is applied and yet there may be a delayed hole.

Amalgamation and Roasting Practice in Gold Coast Colony

BY PAUL T. BRUHL*

Details of the amalgamation and roasting practice at the Prestea Block A mill in Gold Coast Colony. To these are added notes from Mr. Bruhl's observations as to the correct procedure under varying conditions and care of equipment.

I SHALL limit myself in this article to a consideration of the amalgamation and roaster practice in the Prestea Block A mill, the most important plant in the Tarkwa and Prestea gold fields, in the Gold Coast Colony, Africa. A screen analysis of the amalgamation feed was as follows: + 30 mesh, 2.65%; + 60 mesh, 34.37%; + 90 mesh, 16.51%; + 120 mesh, 6.19%; and — 120 mesh, 40.28%.

The equipment consisted of 22 side-shaking plates making 180 shakes per min. and actuated by a 10-hp. motor; a clean-up barrel five feet long and three feet in diameter, and two Berdan pans. On day shift the plates were scraped at the head end with steel scrapers and then rubbered up. As the lower end was nearly always stained and scoured, it was cleaned with a little fine sand and ammonium chloride and re-amalgamated. Mercury was sprinkled on, and rubbed in well with a scrubbing brush. The plate was next rubbered up, the surface smoothed with a soft brush, and the final touches given under a stream of water to prevent oxidation of the freshly cleaned plate.

NOTES ON CARE OF PLATES

The practice of furrowing the amalgam at the head of the plate with the fingers is not to be commended when the feed contains an appreciable quantity of sulphide particles. The plate ought always to be washed with water and hard-scrubbed after the use of ammonium chloride, which leaves the amalgam surface unclean. The pulp would remove the stains in the course of time, but until such time as it does, the plate is not at its highest efficiency. Should the plate be scoured to bare copper, I see no serious objection to the use of a weak solution of potassium cyanide, as it prepares the plate for re-amalgamation much more quickly than does ammonium chloride. The use of cyanide is considered inadvisable by some, owing to its solvent action on gold, but I am of the opinion that the time saved is worth more than the minute quantity of gold that may be lost.

Further, cyanide solution is said to harden amalgam. If the plate be sprinkled with mercury, and a little amalgam be added, this objection does not hold good. Too much amalgam should not be scraped off, for a closely scraped and rubbered plate is always "slippery," and therefore not suitable for catching the gold. Again, as the plates are dressed every eight hours, enough mercury must be added to keep them soft during that period. A clean plate retains less mercury than does one with a quantity of amalgam on it, and thus it either becomes hard before the end of the shift or, if a little more than enough mercury has been added, "tears" form on the surface and run down into the traps. It is preferable, however, to have too wet than too dry a plate.

*Nevada Consolidated Copper Co., McGill, Nev.

CYANIDE IN MILL WATER KEPT PLATES BRIGHT

Owing to the shortage of water on one occasion, creek water was used into which about 60 tons of 0.10% KCN solution flowed per day after passing through the waste-extractor box. The return water to the battery therefore contained a small percentage of cyanide. The plates during this period became bright, hard and frosted in appearance. They "came up" well after the clean-up and, from the point of view solely of cleanliness, the trace of cyanide in the mill water was an advantage. After the first day or two the plates remained bright, although they were not so hard. They were 11 ft. long, 4 ft. 8 in. wide, with a grade of 6%. This was too steep for large tonnages, taking into consideration both quantity of pulp and coarseness of the feed. To prevent scouring of the plates, as the result of a broken screen above, a spitzkasten was installed at the head of each branch launder, the underflow feeding three Bigelow amalgamating pans working in parallel.

A stain should be carefully removed and preferably a little amalgam should be rubbed in at the spot where it occurred; otherwise the discoloration commences to "creep" up the plate, and so gives rise to further trouble. The light stain sometimes seen on a good plate is easily got rid of by rubbing in a sprinkling of mercury. The splash boards should be kept soft, as otherwise pieces of hard amalgam may break away and pass into the riffles. The layer of amalgam on them should not be thick.

PREPARING OLD PLATES

Some old plates, which had been scaled, had to be prepared for use. They were scoured with clean coarse sand, wet with strong cyanide solution, and then well scrubbed, after an addition of mercury, until most of the surface had been amalgamated. Soft amalgam was then added and well rubbed in, cyanide solution being used again. After a light feed had been run over the plates for a few days, they were in excellent condition. The plates were dressed on afternoon and night shifts exactly as on day shift, except that the scraping was omitted.

The "black sands" and iron oxide that collect at the head of the plate should always be removed. If much amalgam is scrubbed up it can be rubbed in at the upper end; if only a little, it may as well be removed with the "black sands." It is not necessary to keep a thick layer of amalgam on the plates, for if the surface is spongy with a layer $\frac{1}{16}$ in. in thickness, any quantity in excess of this is of no practical value. The mercury used in dressing should be scrupulously clean. Retorted mercury always contained impurities in the form of scum,

which was removed by skimming, by pouring the mercury from one bucket to another, by agitating under warm dilute nitric acid and then filtering (the apex of the filter paper was pricked so as to allow minute globules to fall into a solution of potassium cyanide), and finally by squeezing through a double thickness of muslin. A globule of the mercury would now roll down a glass plate without leaving any trace of impurities.

The daily "scrape" was ground with mercury in a Berdan pan, the iron particles being removed with a magnet. About 60% of the gold in the plate heads was recovered by amalgamation. Fine-grinding was not practiced, because it was desired to keep the percentage of slimes, which were not treated, as low as possible, and to prevent the liberation of graphite, which caused trouble in the sands cyanide vats. I believe a flotation plant has been installed, and a better recovery is now made, as the graphite is floated off with the concentrates.

Procedure at Monthly Clean-up

At the monthly clean-up the plates were steamed for two hours, then scraped and scoured for two hours, six "boys" to the plates. The scouring was done with clean sand and "blocks," made by wrapping iron gauze round rectangular blocks of wood. Mercury was added at the rate of approximately 7 lbs. every half hour. After an hour's scouring, all the sand and amalgam was pushed to the head of the plate and the sand was washed down into the foot launder, the discharge pipe of which was of course plugged. The plate was rubbered up closely and the riffles were cleaned out onto the plate, which was scoured for another hour and then sluiced down and dressed. Judgment must be exercised in determining the duration of the scouring. It is inadvisable to try for a record clean-up if the setting of a new record spells ruination to the plates; records may be too dearly bought. Personally I considered a 45-min. scour ample, followed by a second scour lasting 30 min. Each of the plates yielded 110 to 140 oz. of amalgam. The steamed amalgam was put through the Berdan pans and squeezed into slabs of 500-600 oz. in a mechanical squeezer; all other amalgam was hand-squeezed into 100 to 150-oz. balls, though I think 80-oz. balls are the most convenient for retorting and subsequent melting down.

When the mill stopped for the monthly repairs, the riffles, distributors, launders and traps were cleaned out. Any large pieces of amalgam recovered went to the Berdan pans; the cocoanut mattings were hand-picked and brushed and then stored for burning. All other material went to the barrel for 16 hours grinding. The slag from smelting was ground for 16 hours; one-half bucket of mercury was then added and grinding continued for four hours more. The barrel, on being cleaned out, usually yielded 10 oz. of amalgam. The slag was dried, sacked and shipped to England.

Roaster Pan Clean-up

The buckets of material from the roaster pan were washed under a tap, the large pieces of iron picked out, and the residue was floated in a bucket of mercury, the amalgam sinking to the bottom. The skimmings went to the Berdan pans, and after four hours were floated in another bucket of mercury, the second skimmings going to the barrel for 16 hours.

When a large bowl of skimmings from the daily amalgam had been collected, they were squeezed as free as possible from mercury and put in the Berdan pans for four hours. After the addition of two cups of mercury, the pan was cleaned out into one-half bucket of mercury, any skimmings being re-ground for two hours.

The iron that had been "magneted off" was ground in the barrel for 48 hours, three-quarter bucket of mercury was added, and grinding continued for four hours. The iron was cleaned out and sieved in a tub of water, the coarse and fine particles being "panned" separately and "magneted." One and one-half drums of iron yielded 65 oz. of amalgam. A drum was 2½ ft. high by 1½ ft. in diameter.

Roaster Department Practice

The plant started with one Edward roaster, side and end fired; the gases passed to flue-dust collecting chambers, and thence up the stack. The concentrates were charged by means of a belt conveyor into a hopper from which, by means of a screw-feed, they were discharged into a push conveyor at the fire end of the furnace so as to eliminate moisture. No great amount of moisture was, as a matter of fact, removed in the travel of the concentrates along the furnace top; and as the conveyor went out of order rather frequently, thereby causing delay and necessitating the expense and irregularity of hand feeding, I think the plan of feeding directly from the hopper into the furnace is preferable. At about the fourth rabble from the feed end, the charge gives off white fumes and begins to spark; it becomes hotter and hotter as it is worked down the furnace, and the discharge is at a bright red heat. The fires should not be too fierce, for a high temperature causes the charge to clot and thus to receive a bad roast.

Wood was employed as fuel. It is important that the firing should be regular, in order that a uniform heat may be maintained. Later, a new furnace, on the regenerative principle, was erected, the gases passing over the charge and then under the hearth before going up the stack. It had greater capacity, and did better work.

Grinding Followed Roasting

After roasting, the concentrates (which now weighed 30% less) went to Bigelow pans. The charge was divided equally between two pans, the overflow from the lip discharge of each pan going to another pan for regrinding, making four pans in all. The roasted concentrates were crushed in 0.5% KCN solution, and amalgamation was practiced in the first two pans. At each of these was placed a drum containing a 5% lead acetate solution, the rate of drip being regulated according to the condition of the roast. From the regrinding pans the pulp streams flowed to whichever agitator was being filled. The agitator (12 ft. dia. by 8 ft. high) took about 24 hours to fill, and the charge was then further agitated for 48 hours.

The pulp flowed by gravity to a monteju, and thence by air pressure to a 50-leaf Dehne filter press. A cake contained about 163 lb. of dry slime. The charged press was given three washes from the barren solution tank, and two water washes or more if necessary. The auriferous solution from the agitator had a cyanide content of from 0.25% to 0.3%, the drainings from 0.02 to 0.05%. Twenty pounds of lime were added per shift to

the roasted concentrates, and the same quantity was thrown into an agitator after it had been filled. About 30 lb. of cyanide in solution was added to an agitator during filling.

The protective alkalinity was kept latterly as high as 0.1% CaO; previously it had ranged from 0.003 to 0.009% and had given satisfactory results on light feeds. On one occasion after an agitator had been filled, it was noticed that the cyanide content had fallen to 0.02% from the average value of 0.275%. While the agitator had been filling, the roast had been exceptionally poor and both air-lifts out of order. The charge was pressed, and the residues, which showed a high assay value, were re-treated. Apparently, therefore, as the washing in the press had been thorough, the gold in the charge could not have been dissolved out satisfactorily.

This may have been due to the great destruction of KCN, owing to the bad roast or to the lack of sufficient oxygen in the pulp, which latter delayed the solution of the gold. The rich residues were hand fed into the pans and re-agitated with excellent results. A screen analysis of the roasted concentrates before and after grinding is appended.

SCREEN ANALYSIS OF ROASTED CONCENTRATES

Mesh	Before Grinding	After Grinding
+ 30	5.5	1.05
+ 60	14.1	0.91
+ 90	33.5	3.62
+120	6.1	2.70
+150	9.6	4.83
+200	12.45	5.48
—200	18.88	81.38

Experiments on cyanidation of the flue dust were conducted with the following typical results. In No. 1, agitation with KCN was employed without roasting. In No. 2, two hours' roasting was followed by agitation with KCN.

RESULTS OF CYANIDING FLUE DUST

	No. 1	No. 2	
		A	B
Solids in feed	25%	25%	25%
Strength of KCN solution	0.5%	0.5%	0.51%
Pounds CaO per ton	50	30	50
Hours agitation	24	24	24
Strength of KCN after agitation	Nil	0.48%	0.5%
CaO after agitation	0.01%	0.112%	0.124%
Assay value of heads	$44	$44	$44
Assay value of residue	$32	$5.25	$4.60
Percentage recovery	27.6%	88.2%	89.7%

As_2O_3 before roasting, 7%; after roasting, trace. Loss in weight during roasting, 17%.

Utilization of Low-Grade Minerals in Germany

Comment has been made in the *Journal* of the reduced tenor of the ore now being treated in the Mansfeld copper district in Germany. The cupriferous schists formerly treated averaged about 2.5%, while the material now being handled is as low as 1% or even 0.7% Cu. *Echo des Mines* of Dec. 2, 1917, comments further on an address of P. Krusch, reproduced in *Stahl und Eisen* of July 19, 1917, in which he stated that, following the stoppage of importation and the advance in prices, German metallurgists had been led to utilize materials which in times of peace were considered too poor to be commercially available. In many cases good results have been obtained by the application of new methods, and he predicted that minerals of lower grade would be utilized in normal times. He commented on the reduced grade of the ore now treated in Mansfeld district, but stated that no great change had taken place in the metallurgy of iron and steel; lean pyrites and low-grade phosphate rock, however, were no longer rejected.

Vanadium for steel was found in sufficient quantity in slags which contained not more than 0.7% vanadium. The wolframite of old abandoned dumps and slag skimmings serve as a source of tungsten. Chromite of 24% grade is now welcome, although only half the grade formerly accepted as worthy of exploitation. For nickel, material averaging 1.5% is treated. Bauxite containing 40% alumina is now considered sufficiently rich, and metallurgists have likewise arrived at the point of extracting aluminum from clay. No special change has occurred in the production of arsenic and antimony, but sulphur, which for a long time was obtained only in the free state, is now extracted from gypsum and anhydrite. Phosphate rock of 20% grade is being transformed into fertilizer.

South African Mineral Production in 1916

The annual report of the Department of Mines and Industries, Union of South Africa, for 1916, contains the following information relative to the mineral production for 1915 and 1916:

Product	Quantity, 1915	Quantity, 1916
Gold, fine oz	9,096,410	9,296,963
Silver, fine oz	966,176	968,935
Diamonds, carats	103,385	2,346,330
Coal, tons	8,281,324	10,007,502
Coke, tons	7,279	10,704
Tar, gal	26,050	.....
	Tons	Tons
Copper matte, 45.2% copper	28,969.769	22,841.653
Tin concentrates, 67.5% metallic tin	3,441.353	3,264.068
Asbestos	2,138.473	4,655.837
Graphite	41.458	60.154
Magnesite	627.000	609.120
Antimony	89.669	721.662
Lead	180.250	402.000
Zinc	352.396	.....
Corundum	68.126	755.305
Nickel	2.500	.....
Sheelite	.....	1.423
Mica	2.000	13.496
Iron Pyrite	545.000	5,276.700
Keolin	20.000	.....
Iron Oxide	.....	22.400
Talc	44.000	132.000
Salt (including byproducts)	45,104.000	56,267.000
Soda (crude)	6,303.000	6,299.000
Lime	68,989.000	78,222.000
Flint	453.000	297.000
Gypsum	2,838.000	3,990.000

The total value of the product in 1915 was £45,531,009, while the 1915 production was valued at £50,593,359. Both gold and silver show an increase. The diamond production is greatly in excess of the 1915 production, but lower than that of 1914. Copper production is 6128 tons less than in 1915.

Transvaal mining concerns in 1916 produced 28,542,650 tons of ore, and employed 229,926 men in 90 mines, of which 83 were producing and seven non-producing. In December, 1916, 9765 stamps and 326 tube mills were in operation.

Ultra-violet Rays in Arc Welding, produced by the electric arc between carbon and iron or iron and iron, are harmful to the welder, according to W. S. Andrews in the *General Electric Review.* Operators must therefore be careful to employ protective screens and lenses. Proper use of the latter will shield the eyes of the welder against these rays as well as against glare, flickering and intense heat. Such welding should be done behind screens where it will not effect other workers in the shop.

Fine-Grinding and Porous-Briquetting of the Zinc Charge*

To reduce the consumption of coal in the zinc charge, at present about 400% in excess of theoretical requirements, it is proposed to fine-grind and briquet the ore and fuel, producing a kernel ½ in. in size, and to effect a saving in fuel expense and an increase in the "ore capacity" of the retort.

THE object of this paper is to describe the several necessary characteristics of the zinc-retorting charge and to show how by certain improved methods, the large excess of coal, over that theoretically required, can be reduced, thereby effecting an increase in the smelting capacity of a retort plant as well as certain other economies.

Present Charging Conditions in the Southwest

In the Southwestern zinc works a charge of roasted zinc ore with a side mixture of carbonates and silicates, analyzing on the average 50% Zn, is mixed with 55% or more of its weight of a mixture of coal and coke analyzing 60 to 70% fixed carbon. The ore is of varying fineness and the coal and coke are usually crushed in a semi-moist condition through a ⅜-in. screen. With ores of a slaggy nature, this coal proportion is increased, sometimes to as much as 100% of the weight of the ore. With carbonate ores, or where anthracite screenings with higher carbon content are cheap enough, the percentage of reducing agent is cut to 45%, or even somewhat lower. The average charge per retort for a monthly run of a plant on ore, as distinguished from retorts on blue powder, ladle skimmings and other intermediary products, runs from 60 to 66 lb., with a mean of 63 lb. for the Southwest with standard retorts of 8½-in. inside diameter and 50-in. long inside, using roasted sulphide ores. Conditions will change these figures, but 40 lb. of ore per cubic foot of retort space is, I believe, an average in the better operated plants. Since the rise in the price of spelter, the tendency has been to overcharge. To remove the slag that is formed when retorts are overcharged, extra men are put on to "gum-chisel" the retorts to prevent "set" furnaces and "butchered retorts."

Taking the above conditions as premises, one finds that from four to six times the amount of coal necessary for the reduction is used, as is evidenced by the fact that the residues analyze as high as 35% fixed carbon. There are good reasons why this excess of fixed carbon must be used, and perhaps these can be best explained by a description of the metallurgical requisites of a zinc charge. They may be enumerated as follows:

Metallurical Requisites of the Zinc Charge

1. High reducing power, especially at the end of the shift, to reduce any carbon dioxide to monoxide and bring about a good condensation of the vapor. It is, of course, well known that carbon dioxide, if formed in the retort, oxidizes the zinc vapor at lower temperatures and is the cause of the formation of an excessive amount of blue powder.

2. Heat conductivity as high as possible, so as to permit the heat, as soon as it permeates the walls of the retort, to flow to the inside of the charge in order that as uniform a temperature as possible may be attained in the retort. For this reason large pieces of coal, ore, and coke are charged, since fine material is a poor conductor of heat.

3. Porosity.—If the charge be too dense, the back pressure of the gases produced is so great that reduction is hindered. Moreover, the porosity allows the secondary gaseous reduction to proceed.

$$ZnO + CO = Zn + CO_2$$
$$CO_2 + C = 2CO$$

4. The charge must leave a residue that is substantially non-slagging in character. Since carbon is infusible, this can be attained by having sufficient fine carbon present in the charge to leave particles of carbon in the residue. Since the fine particles are predominantly consumed or oxidized in the reduction of the ZnO, these must be present to a certain excess in order to leave enough fine coal particles at the end to act as a sponge and stop any slag from attacking the retorts.

Theoretical Fuel Consumption Approached in Experiments in Electric Smelting

In my work on electric smelting where only 12% of coal was added, it was shown that it was possible, operating on a fairly large scale—one ton of charge per day—to reduce zinc ore successfuly with only the theoretical amount of coal. This seemingly incongruous fact points the way for certain improvements in the ordinary reduction of zinc ore in the retort. Accordingly, the above analysis of the requisites was made and investigation and research were started to find the metallurgical ultimate.

Coal-dust firing, used successfully in the cement and smelting industry, was taken as a pattern. In this, the almost instantaneous oxidation of carbon is attained by the use of coal in the form of dust. Since any reduction process is likewise an oxidation process, it is not fanciful to regard zinc reduction as an oxidation of the "charge" coal. Accordingly tests were made, grinding both the zinc ore and the coal to 80-mesh and finer. These fine mixes were worked off in a crucible or in a retort, and while they brought out certain advantages they also showed conclusively that the fine charge had the disadvantage of being so dense as to hold back the zinc vapor and gases, and so to diminish the speed of reaction. In the conventional furnace, large pieces of coke are put in to "ventilate" the charge. Accordingly an addition was made of broom straw, which gives a carbonized skeleton that is preserved during the retorting operation and provides an exit path for the gases. Moreover, the carbonized skeletons or eductors are an ashless and very active form of carbon, and thereby reduce the carbon dioxide to carbon monoxide. Since the flow of the gases

*A paper to be read by Woolsey McA. Johnson before the New York meeting of the American Institute of Mining Engineers, February, 1918.

naturally takes to these eductors, this super-reduction is efficient in improving condensation.

In these tests, the percentage of reducing material was gradually decreased, from 60% to 50, 40, 30, 25 and 20% successively, and it was found that with complete reduction (residues analyzing from 2 to 0.5%Zn) there was no slagging of the ore, provided the proportion of coal was left above 20%, unless the ore was especially slaggy. For instance, using an ore analyzing Zn 22%, Fe 33, S 3.8, SiO_2 6.4, CaO and alkali 4%, with 20% of anthracite, there was slight fritting, but none with 25% of coal. In general, with reducing coal analyzing fixed carbon 67.0%, volatile matter 26.6, ash 12.4% and an ore analyzing Zn 43.5%, Fe 7.10, CaO 40% or even more, there is no trouble in getting residues that contain absolutely no "gum" or slag and analyzing in zinc as follows: 2.1%, 0.6, 2.9, 2.1, 1.8, 0.5%. The ore charge per retort was thus raised to 100 lb. and the coal percentage reduced to 30% or lower.

The reason for this is that the charge is highly reductive, due to its fineness and the peculiar way it is "ventilated," and since the immense number of fine particles of carbon left at the end hold up the slag-making particles and any iron sulphides, little gum is formed, and if formed it does not touch the retort walls. Instead of the carbon particles passing through the process without oxidation, many of them ⅜ in. in diameter, and without performing any useful purpose, the surface of the particles is increased forty- or fifty-fold, and if one holds to the original simile of coal-dust firing and remembers that in zinc reduction two solid reagents must be made to combine, one cannot but admit the great theoretical advantage of a finely ground porous charge.

For practical working, however, a charge must be a fair conductor of heat, for zinc reduction is heat-absorbing. This fineness of the charge, while it certainly promotes the reduction if properly "ventilated," makes the charge a poor conductor of heat, which is a decided disadvantage in the practical retorting operation.

Briquetting Increases Heat Conductivity and Retort Capacity

This poor conductivity is overcome by briquetting, which causes a certain lessening of the volume, but at an expense of $1.50 per ton of ore. But since the density of coal is less than half that of the ore, the reduction of the percentage of coal from 60 to 30% or less increases the pounds of zinc ore per cubic foot from 42 to 63 lb., or increases the charge per retort from 67 to 100 lb. Assuming a cost of $17 per ton of ore for smelting under present conditions, fine-grinding, ventilating and briquetting permits a reduction in cost, by means of increased charging, of $5.67. The reduction in "charge" coal cuts the cost of coal from $2 to $1.20. There would be a reduction in furnace labor and in retort consumption because the charge gives a residue that blows out clean. I believe that the recovery will be increased because of low residues and decreased retort consumption; perhaps this saving will amount to $3. The credits thus total $10.97 while the debit is $1.50; or a total net saving of $9.47 is possible.

The briquetting needs a special binder and, after mixing, can be effected by extruding through a pug mill, followed by warming or heating, leaving a partially reduced mass in various sizes suitable for charging in the conventional manner. The size of these kernels should be about ½ in. diameter.

Concluding, it may be stated that the present method of using a 400% excess of reducing coal is unscientific for the reason that such an overwhelming excess is not needed. Whether the reduction be done by solid carbon or by carbon monoxide, coal that passes through the process to a large extent in large particles, not acted on at all, serves no useful purpose except to make the charge heat-conductive. Fine grinding of coal and ore (unless it be flotation concentrates) utilizes to the maximum efficiency the coal and produces certain collateral advantages. The "kernel" briquetting gives the necessary heat conductivity. The commercialization of this proposal would, in my judgment, effect an important national saving in coal, zinc and labor.

Effect of Copper on Steel

To obtain additional data on the mechanical properties of medium-carbon steel containing small quantities of copper, an investigation was made by Carle R. Hayward and Archibald B. Johnston, which they have described in a recent paper.[1] Two grades of steel were used, which are referred to in the account of the test as "high-copper" steel and "low-copper" steel. Chemical analyses showed the following compositions: High-copper steel —0.380% C, 0.012% P, 0.570% Mn, 0.030% S, 0.860% Cu; low-copper steel —0.365% C, 0.053% P, 0.590% Mn, 0.048% S, 0.030% Cu. The steel was furnished in bars about 1 in. square in cross-section. A more suitable form for heat treatment was secured by turning these down on a lathe to ¾-in. round bars. The steel as forged was very soft and turned easily.

The tensile tests were made in an Olsen testing machine; the shock tests on the Charpy machine at the Watertown Arsenal, and the hardness of the specimens was determined by the Brinnell and scleroscope methods. The results are summarized by the authors as follows:

"The tensile strengths show a striking superiority of the high-copper steel. The yield point and ultimate strength are in every case higher, where the ductility is practically the same, although here too the average figures for reduction of area are with one exception slightly higher for the high-copper than for the low. This, however, is offset by slightly higher values for elongation in a majority of the tests in favor of the low-copper. The hardness tests by both methods show the high-copper steel in all tests to be harder than the low-copper. The Charpy shock tests show the high-copper steel in all cases to be superior to the low-copper.

"In general, the results confirm the work of Ball, Stead, Breuil, and Campbell as regards the effect of copper on hardness and tensile strength. They confirm the work of Breuil as regards brittleness and the work of Campbell as regards reduction of area. It is also true, that, as Stead has stated, the behavior of the copper steel resembled that of nickel steel."

Asbestos in Great Britain may be dealt in only by permit. Effective Jan. 5 last, the Admiralty prohibited the sale, supply or delivery of any raw asbestos, according to a cable from the American consul general at London.

[1] "The Effect of the Presence of a Small Amount of Copper in Medium-Carbon Steel"; a paper presented at the February, 1918, meeting of the American Institute of Mining Engineers, at New York.

Sulphur and Copper Oxide Determination

By C. G. MAIER*

A method has been developed in the research laboratory of the Phelps Dodge Corporation of determining the sulphide copper in samples, in the course of which any metallic copper present is removed by amalgamation with mercury. Under the method customarily used, such metallic copper is erroneously estimated as sulphide copper.

THE analytical determination of "oxide," or acid-soluble, copper in ores and mill products is a matter of some importance for the control both of roasting and leaching and of concentrating operation, especially flotation. The usual method of making this determination, without going into details, is to treat the weighed-out portion of the sample taken for analysis with dilute sulphuric acid, bringing just to a boil, followed by filtering, washing and determining the amount of copper contained in the filtrate.

When roasting is carried on as a preliminary to leaching, or when an unroasted ore is to be leached with sulphuric acid, this method of determination is accurate enough for practical purposes, since in both cases what is wanted is the amount of copper soluble in sulphuric acid, and not, except possibly for control of roasting, the true percentage of "oxide" or metallic copper, as opposed to copper combined with sulphur. The object of these notes is to bring out the fact that this method, as applied for the control of flotation operation, may give misleading results.

Accurate Determination of Sulphide Copper Needed To Control Flotation

Flotation, as now practiced, does not pretend to recover more than a portion of the so-called "oxide" copper present, and in the mill reports, therefore, at a number of places, the recovery by flotation is calculated both for the total copper present and for the "sulphide" copper. Finely divided metallic copper may or may not be recoverable by flotation, according to local ore peculiarities, but in any case it is not "sulphide" copper. Cuprous oxide by the ordinary method of "oxide" copper determination will, of course, also yield only half of its copper to the sulphuric acid used as a solvent.

Since the so-called sulphide copper in an ore or mill product is now usually estimated by difference between the total copper and the oxides as determined by treatment with dilute sulphuric acid, it is evident that when such ores or products carry metallic copper or cuprous oxide in appreciable amounts, the determination of sulphide copper will be in error in proportion to the amount of metallic copper present and in proportion to one-half of the cuprous oxide present. Such ores are treated by flotation in a number of places, and a method for accurately determining their true sulphide content is therefore of interest.

The following method is suggested for this purpose: Weigh from one to three grams of the sample, depending on the copper content, into a 150 c.c. casserole, add 50 c.c. of 4% H_2SO_4, and heat to 80-90° C. for 30 to 45 min. Avoid boiling. After this treatment, cool to room temperature and add 4-5 c.c. of clean mercury. Rub the mercury about in the bottom of the casserole or beaker with finger or otherwise until it is certain that all the ore particles have had an opportunity to come into contact with it. Three or four minutes' rubbing with the finger will usually suffice. Under these circumstances the metallic copper is usually amalgamated and is taken up by the globule of mercury. Pour the supernatant solution, containing the sulphide minerals and gangue suspended in it, into a beaker, taking care to retain the mercury as a single globule in the casserole. Wash the last traces of ore into the beaker by means of a fine stream of water.

The mercury having removed any original metallic copper and also any resulting from decomposition of cuprous oxide, the solution is now filtered and the copper in the residue and filtrate determined in the usual manner, preferably by the iodide method. The copper in the residue represents, of course, the sulphide, while that in the filtrate represents the so-called "oxide" or, rather, acid-soluble copper.

Notes on Procedure

While the method as outlined above has given good results in the laboratory in which the analyses were made, the following points, more or less obvious in themselves, are worthy of note: After washing the ore from the mercury, it may be desirable, if much metallic copper is present, to add a second fresh portion of mercury to insure complete separation. Ordinarily, if a little care be used, this will be unnecessary, but it may be desirable as a means of insuring complete separation.

It is sometimes a little difficult to wash the last traces of ore from the mercury. This may be facilitated by pouring the mercury from one casserole to another. The ore has a tendency to stick, while the mercury comes over all in one globule. The ore thus left sticking to the casserole should be washed into the beaker. With a little care and practice the washings may be made without too large an amount of water, 100-150 c.c. usually being sufficient.

In determining the copper in the residue from filtration, it is possible to put the wet filter paper directly into a beaker and treat with HNO_3, HCl, H_2SO_4 and a little bromine, and dissolve, at the same time destroying the filter paper. Usually, evaporation must be made twice to destroy the paper completely. The partial carbonization of the paper, however, leaves a gelatinous residue, which has a tendency to froth over, so that, where it can be done conveniently, it is well to dry and ignite the filter paper.

When it is undesirable to redistill the mercury for use a second time, it may be purified sufficiently by filtering through chamois and allowing to stand for some time in contact with dilute (5%) HNO_3.

The method has been tested in the Phelps Dodge laboratory on widely varying ores with entire satis-

*Assistant chemist, Research Department, Phelps Dodge Corporation.

faction. A few determinations are given as typical of the results achieved:

1. A material typical of flotation concentrates, containing only sulphide minerals with a small amount of oxide but no metallic copper, when analyzed by the usual method was shown to have the following composition: Total Cu, 24.47%; acid soluble Cu, 0.24%; sulphide Cu by difference, 24.23%. To another portion of the same sample was added 1% of finely divided metallic copper. Analysis by the new method, the added copper being removed with mercury, gave the following results: Cu in residue or sulphide Cu, 24.18%; acid-soluble copper, 0.22%; total Cu by sum, 24.40%.

2. On analyzing a concentrator slime a typical result obtained is as follows: Total Cu, 0.52%; acid-soluble Cu, 0.20%; sulphide Cu by difference, 0.32%. The new method gave this analysis: Cu in residue or sulphide Cu, 0.31%; acid-soluble Cu, 0.20%; total Cu by sum, 0.51%. This slime quite evidently did not contain metallic copper in larger quantity than the error of determination. Consequently, in order to make a test on this class of material, 2.2% of fine metallic copper was added. The new method on the slime plus the added metallic copper gave the following results: Cu in residue, 0.33%; acid-soluble Cu, 0.20%; total Cu originally present, 0.53%.

3. On an actual ore (Old Dominion ore, Globe, Ariz.), containing metallic copper and suboxide copper, results were obtained by the usual method as follows: Total Cu, 5.26%; acid-soluble Cu, 1.92%; sulphide Cu by difference, 3.34%. By the new method the results were: Cu in residue or sulphide Cu, 2.49%; acid-soluble Cu, 1.92%; metallic Cu by difference, including ½ of Cu present as Cu_2O, 0.83%. On this ore the error in the sulphide copper determination by the old method is 0.85% (3.34 — 2.49), an amount sufficient to affect seriously the calculation of sulphide copper recovery by flotation.

In order to check the new method further on this ore, another portion of the same sample was taken for analysis, and to this was added 2% of metallic copper. A re-assay then gave the original amount of metallic copper as 0.83%, a very good check with the first determination of 85 per cent.

Method Compares Favorably with Others

It is apparent that under the conditions of these tests the method is about as accurate as the ordinary run of copper determinations and that a separation may be effected to within a few hundredths per cent. of copper. As with many other methods, some practice and considerable attention to details are necessary for accuracy, but, when carefully followed, the method is believed to be capable of yielding good results, and, though tests on it have not yet covered a sufficient period of time to determine its ultimate usefulness, there seems to be no doubt as to its practicability.

It also seems that the method may be of value in the control of roasting operations when it is desirable to know the amount of sulphide copper present in the calcines. Tests have not been made in the Phelps Dodge laboratory on calcines, but it seems probable that accurate results may also be had with such materials. Credit should be given Mr. Rankin and Mr. Harnden for coöperation in the work described.

Scope of a Miner's Employment

By A. L. H. Street*

As affecting an employee's right to recover an award under Workmen's Compensation Law for an accidental injury sustained by him "in the course of his employment," any acts done by him in the interest of the mine and in conformity to custom acquiesced in by the owners must be regarded as having been done in the line of his duty, holds the California supreme court in the recent case of Atolia Mining Co. vs. Industrial Accident Commission, 167 *Pacific Reporter*, 148.

In this case, a mine shotfirer's strict duties ended when he had assisted in drilling holes for blasting, loading and firing them at the end of the shift's working hours. But, under a well-established custom in mining, he returned twenty minutes after the explosions to ascertain that all the shots had exploded, to avoid peril to the incoming shift. In afterward leaving the mine, he was fired upon by a guard employed to prevent thefts of ore, and the mining company denied liability for resulting injury under the Workmen's Compensation Act, on the ground that the injured man had acted as a mere volunteer. The court, however, holds that the accident occurred in the course of employment, saying:

"The recognized custom of miners, carried out with the knowledge and approval of the mine owners . . . becomes in all essentials for this award a part of the duty of the miner in the performance of his work, and his injuries thus resulting grew out of and occurred in the course of his employment."

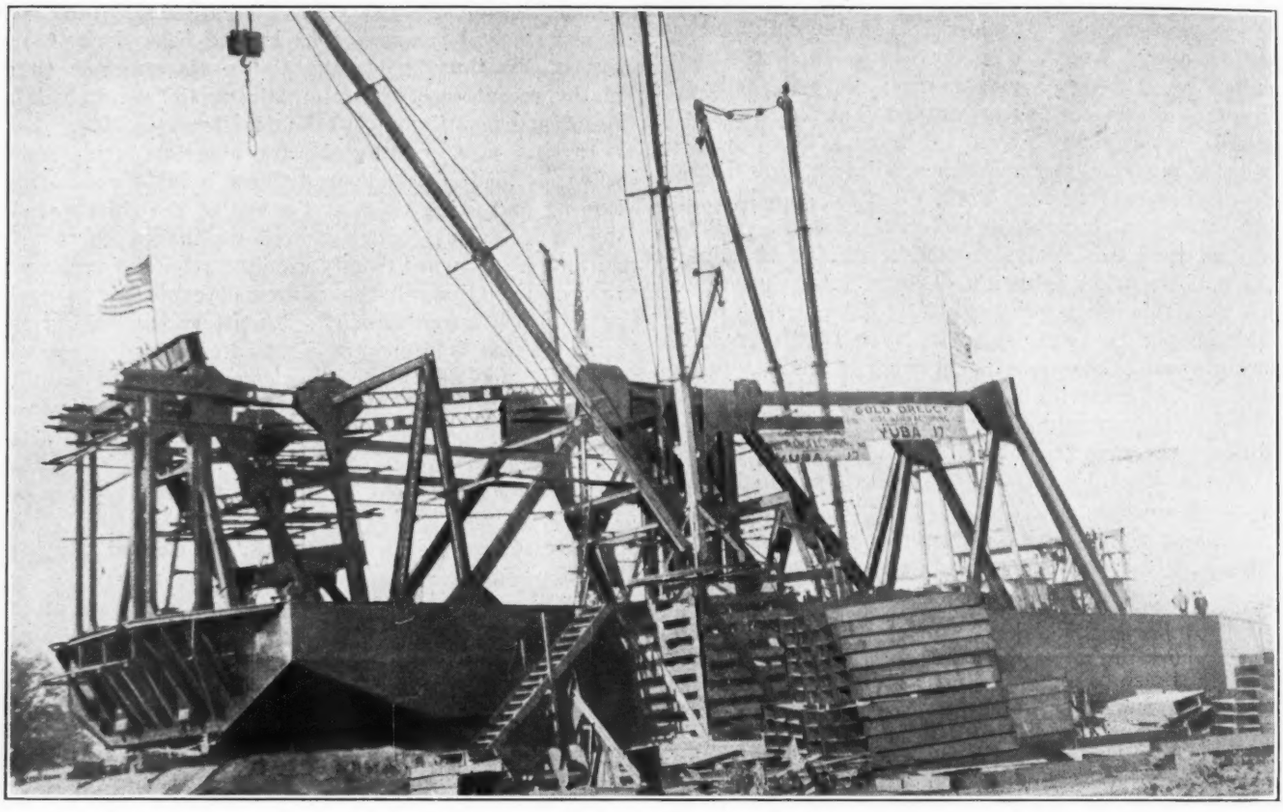
Decreased Iron and Steel Production in Austria-Hungary

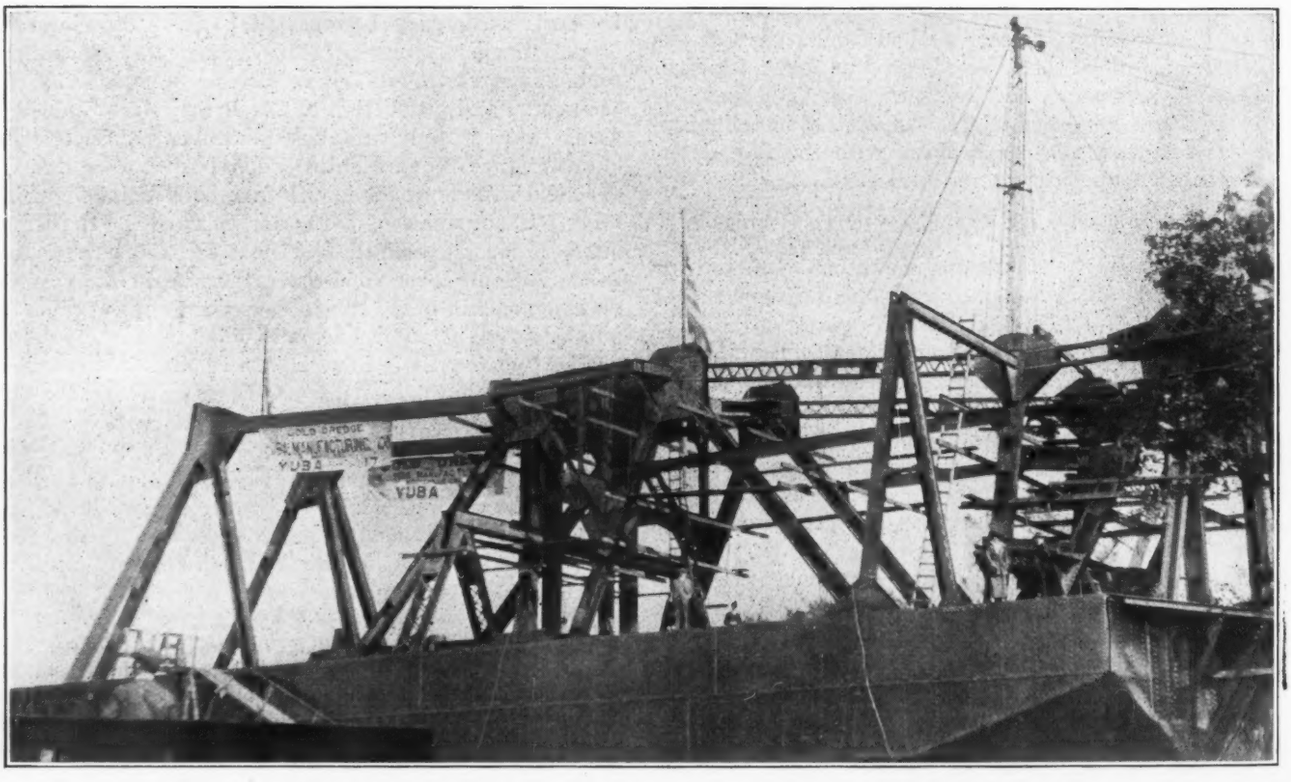
The position of the principal iron and steel companies in Austria-Hungary is reported to have deteriorated, from a financial point of view during 1917, according to the *Iron and Coal Trades Review*. A reduction in the profits and production of the Prague Iron Industry Co. is stated to have taken place in the September quarter; the Alpine Montan Co. reported a decline of $140,000 in net profits in the first half of its financial year, with prospect of a further decrease in the third quarter. It is explained that the causes are to be found in the difficult labor conditions, the rise in the cost of all raw materials, and the increase in wages. There is no possibility of an expansion in production at present; on the contrary, it is impossible to maintain the existing level of output, owing to the decreasing supplies of raw materials and consignments of finished products in consequence of the appropriation of rolling stock for army purposes. The scarcity of labor is another serious factor. Russian prisoners of war tried by the Alpine company were found unfit, and have been discharged. Production of iron ore at the well-known mines in Styria is said to have considerably decreased.

Mercurial Poisoning at quicksilver reduction works was discussed recently by representatives of the Bureau of Mines, the Board of Health of California and the Industrial Accident Commission of that state, in an effort to reduce the danger arising from this cause.

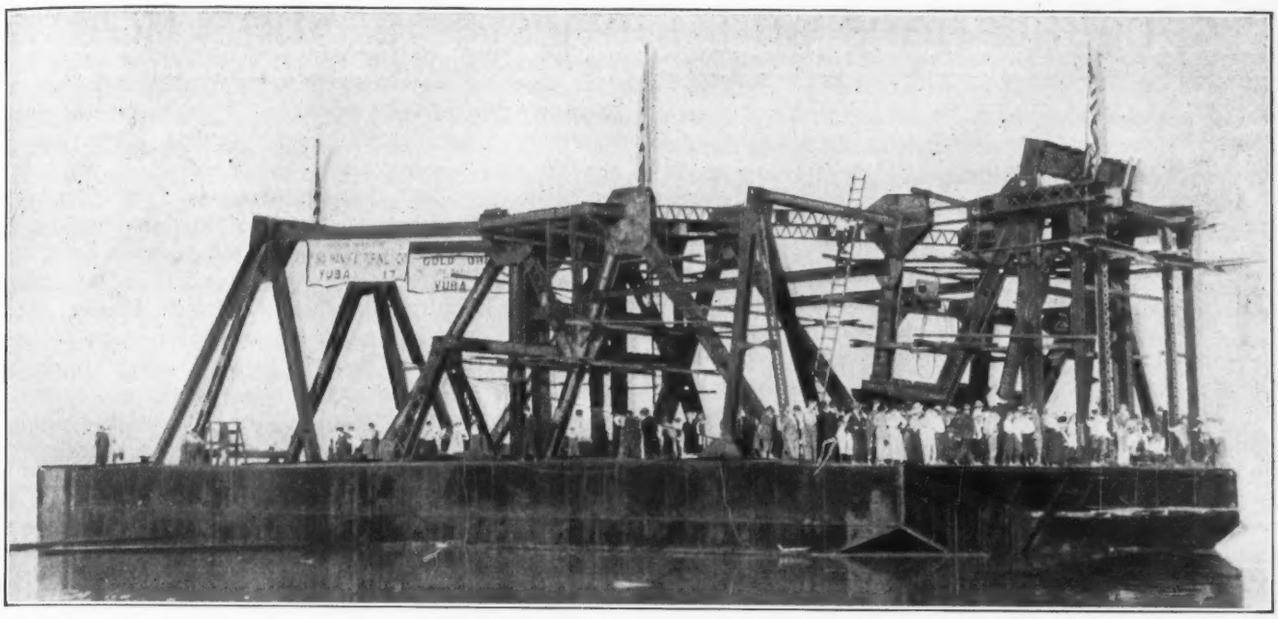
*Attorney at law, 829 Security Bldg., Minneapolis, Minn.

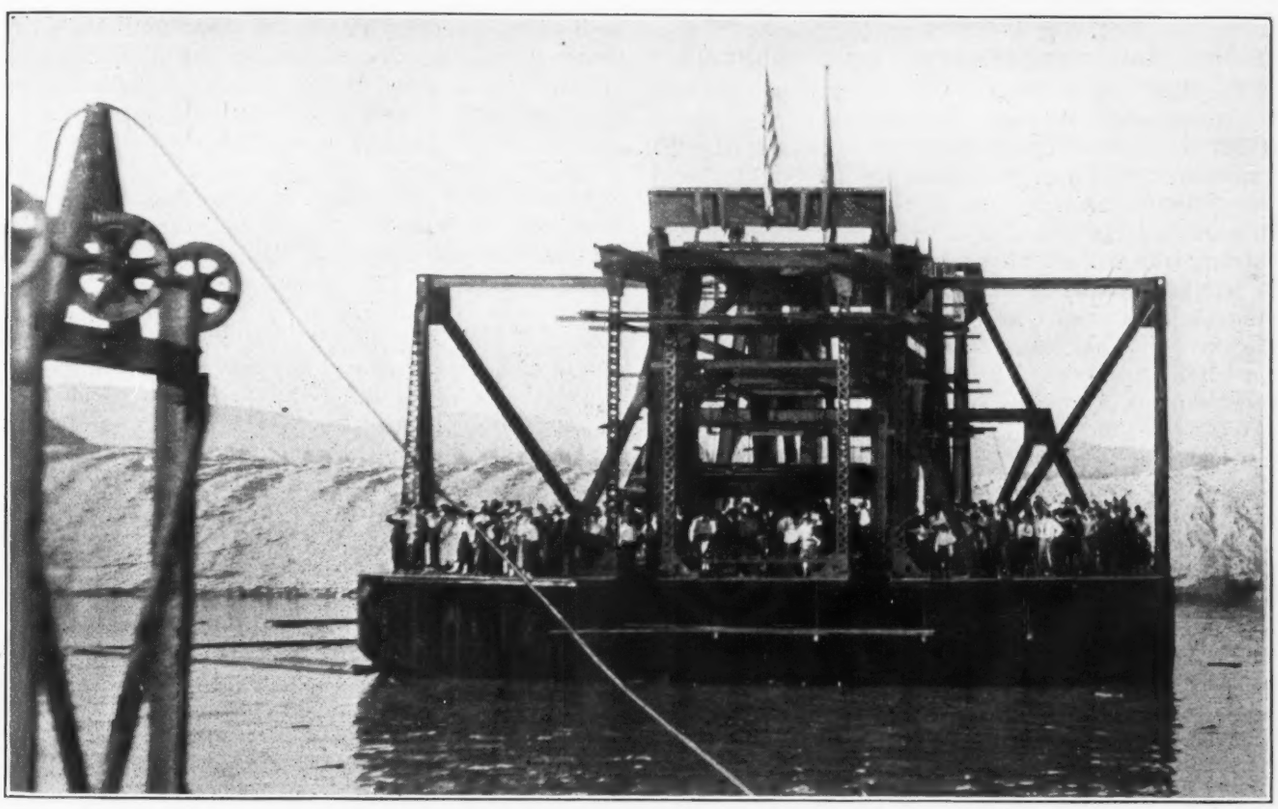
Launching Yuba No. 17 Dredge in California





YUBA NO. 17 DREDGE IN THE WAYS PREVIOUS TO LAUNCHING AT HAMMONTON, CALIF.





THE LAUNCHING OF YUBA NO. 17, SINGLE-STACKER DREDGE, AT HAMMONTON, CALIF., NOV. 4, 1917

The hull of Yuba No. 17 all-steel gold-placer dredge, built by the Yuba Manufacturing Co. for the Yuba Consolidated Gold Fields, was launched at Hammonton, Calif., Nov. 4, 1917. It weighs 700 tons and carried constructed trusses and other parts of the superstructure. The dimensions are: Length, 155 ft.; beam, 68 ft., not including overhang; depth, 11½ ft.; and width of well hole, 8 ft. 7 in. Construction started with the actual laying of steel on Aug. 4, 1917. In the three months there were 12 Sundays, one holiday and one rainy day when work was suspended, making a total of 14 idle days, or 76 days actually spent on construction. The number of men employed in this period varied from 40 to 80. The camp houses or tents were planned to accommodate 125 men, that being the number required in subsequent periods of construction. Yuba No. 17 dredge is practically of the same design and construction as Yuba No. 15. The digging ladder is 154 ft. long, 5 ft. 4 in. wide, 10 ft. 6 in. deep at center and weighs, without buckets and pins, 445 tons. Complete, it is equipped with 100 California type, 18 cu.ft. buckets that are designed to dig 85 ft. below the water line. The buckets weigh 4200 ano the bucket pins 700 lb. each. The bucket idler is 5 ft. 9 in. in diameter, cast in one piece, and weighs 11 tons. The upper tumbler is 5-sided and weighs 15 tons; the shaft is 14 ft. 10¾ in. in length and has a diameter of 48 in. The lower tumbler is round and has a diameter of 5 ft. 5 in. The single stacker is 175 ft. in length and weighs 90 tons; the conveyor belt is 350 ft. long and 44 in. wide. The ladder-hoist winch and the swing winch are identical with those on Yuba No. 15, the stacker drive is the same as Yuba Nos. 15 and 16, and the revolving screen and water nozzles are the same as Yuba No. 15. The spuds are 60 ft. long, 3 ft. 1 in. x 5 ft. in section, and the point is of solid steel and 10 ft. long. The main part of the spuds, which weigh 42 tons each, is built of steel plates and angles.

Qualifications and Duties of a Shift Boss

An address delivered by Joseph P. Hodgson to mine foremen and department heads of the Copper Queen mines, outlining the qualifications and duties of an efficient shift boss and his value to the mining company.

THE object of this address is to assist the shift boss. Having served in that capacity myself, and having some knowledge of the things expected of the shift boss, I have no hesitancy in saying that I know his duties are many and important, and if he is a real shift boss and has a proper conception of his work, he is, without doubt, one of the most valuable men in the employ of the company. If, however, he is only a driver of men, it is entirely possible that he may be a positive injury to both the company and the men. Of the former type (real shift bosses) I know we have a goodly number. Of the drivers only, if we have any—and I know there are few—I sincerely hope they may soon be real "shifters" in the truest sense of the word.

Shift Boss Interprets Company Policy to the Men

The shift boss is the man who really stands between the company and the men. He represents the company to the men and interprets its policy. Consequently, the duties of a shift boss are varied and far-reaching, and go beyond the ordinary idea of "getting out the rock." In working large orebodies of uniform grade his principal duty is to look after the tonnage and, when necessary, to crowd the mine for a still greater tonnage. At a mine like the Copper Queen it is entirely different. Here the shift boss has many other problems, and often he must use his individual judgment. Of these considerations, the one of greatest importance is the work itself.

While the individual responsibility for the employment of men has been practically removed from the shoulders of the foremen and bosses by the substitution of a central employment office under the direction of a man whose object is to secure the most intelligent and best trained men available for the work, the opportunity and duty of the foremen and bosses to "fit the man to the job" is still of supreme importance. In fitting a man to the job, the first question which presents itself is "What are the man's capabilities?" For example, "Can he tell ore from waste?" "Is his temperament such that he unconsciously wants to make a 'big showing' and, consequently, fails to sort the ore as clean as possible?" "Is he physically strong enough to stand up to the job, or can his intelligence be used to better advantage in some other direction?"

For instance, a man physically able to make a splendid worker in a sulphide stope when there is no sorting to be done might be absolutely wasted in mixed ore requiring careful sorting. Of course, over half of the work requires no particular knowledge of ore on the part of the man, and this fact should not be lost sight of in judging a man's value for this part of our operations. In development work, a man trained in railroad tunneling, underground drifting and raising or similar lines will be better fitted for this field than one trained in "chloriding."

So far, we have considered only the question of selecting men already trained. As a matter of fact, in recent years, with the tremendous expansion of metal-mining operations in the West, it is becoming increasingly evident that the supply of trained men is practically exhausted, and to meet this condition it is necessary not only to select men but to train them for the job, and it is here that the shift bosses have their largest opportunity for valuable service. Bosses themselves are selected as much for their knowledge of how to do the work and how to instruct others to do it as for their ability to handle men. These questions of the "selection of the man for the job and his proper training" are, in a way, only secondary to the real constructive work of the boss.

A carpenter selects his materials, tools and methods for the particular job, but first of all, he must have a plan to work to. Similarly, the boss must have his plan complete in every detail and fitted into that of the division foreman, whose plan, in turn, is fitted into that of the general foreman, and so on, each portion, as it were, dovetailed into every other, until the whole makes a complete, self-contained scheme of management, able to take its stand in the mining world—a finished structure, well designed and efficiently operated.

As someone has aptly said, "The authority to issue an order entails the duty of seeing that the order is carried out." Naturally, this involves, besides the knowledge of how to carry it out, careful planning, as otherwise the issuer of the order will not know whether it can be carried out or not. For example, a man may be sent into a drift to drill a round of holes and finds only part of the outfit. He spends a couple of hours "rustling" the rest of the outfit, fails to get in his round and is seriously reprimanded, or, perhaps, in extreme cases, discharged for something that was not his fault, but entirely due to the failure of the shift boss to work out a comprehensive plan in advance of issuing orders.

Shift Boss Should Do Justice to the Mine and to the Men

In the second place, it is the duty of every boss to do justice to the mine itself. First of all in regard to the method of extracting the ore. Small bodies of ore may be easily passed up which may be connected to larger ones that would mean hundreds of thousands of dollars to the company. Of course, there are so many prospects that it is impossible to follow out each so-called break or stringer of ore. Nevertheless, it is the duty of the shift boss to try to recognize a good prospect and report it to his foreman, so that the combined judgment of both men will be exercised. This is an important consideration when one considers that the life of the mine is really at stake and that it may be lengthened or decreased according to good or poor mining—in other words, lack of conservation of the orebodies.

The third consideration is vested in the proper interpretation of this company's policy. In general, the policy of this company is well known. It is to pay good wages in order to have the men contented and at

the same time to operate the mines on a good business basis, so as to reap the maximum amount of profits. The attitude of the shift boss may turn the feeling of the men either for or against the company. In fact, the popularity of the company is really at stake between the shift bosses and the miners.

Fourth is the importance of handling men. Every shift boss should make a study of his men. First in regard to their ability, so as to fit the right man in the right place; and second in regard to discipline, so as to get his good will and his interest in the work, and at the same time have all orders obeyed. At this time, when wages and bonuses are higher than they have ever been in the history of the camp, there is a natural feeling that superhuman efforts must be made to maintain costs at their former level. Obviously, if good work was being done before the increase of wages, costs could not be held down by simply attempting to increase the efforts on the part of the men.

The policy of the company in paying the present high wages is not to obtain the privilege of driving the men any harder, but is to share with them the increasing prosperity of the industry. At the same time the situation does present an extremely favorable opportunity for the study and introduction of new methods for making the same amount of effort more effective. We all know the difficulties encountered in asking an old experienced miner to change his way of doing something, but with the added incentive of more money these changes can be effected much more readily.

Attitude of Men Toward Company a Reflex of the Shift Bosses' Efficiency

It is useless to expect a man to judge of the company's feelings toward him except in the light of his treatment at the hands of his immediate superiors, and this responsibility of the shift boss to represent the company to the men both wisely and well, is, after all, the most important duty to them both. It has been said that justice is man's most important mission on earth. Now, unless a boss thoroughly understands the interplay of the forces set in motion by his orders, he cannot hope to estimate their results justly and distribute praise and blame where they belong. In addition to this there can be no coöperation that is not founded on mutual respect, and "blackguarding" a man, while it may arouse fear and hate, can hardly be expected to arouse esteem and respect.

Without the coöperation of his men a boss is as helpless as a new-born babe. In recognition of this fact, too much importance cannot be laid on upholding his authority and discipline; that is to say, he should hold his men individually responsible for the orders issued to them and should be held personally responsible by his foreman for the execution of all orders issued to him, the foremen, in turn, being held personally responsible for all orders issued to them. This system of responsibility, excepting in cases of extreme emergency, should be adhered to firmly.

Good Shift Bosses One of Company's Best Assets

In concluding these remarks, I hope that each one will realize the responsibility that rests upon him. If you consider everything carefully when giving orders, so as to make it clear to your men just what should be done and see that they have the proper tools with which to do it, then you have the right to expect a reasonable day's work. Of course, you may not always be right, and will make mistakes, like anyone else, but you must remember that you have been selected by your superiors on account of your ability to transmit and interpret their orders, and that in every order you give, regardless of whether it is right or wrong, the company will be back of you and is upholding your judgment, giving you the benefit of the doubt that your judgment is correct until you should prove yourself unworthy of their confidence. The responsibility for good discipline and the good will of the men to yourself and to the company rests entirely upon your shoulders. It is, therefore, of the greatest importance that you try to interpret the policy of the company correctly and to use your best judgment in matters of discipline, presenting orders and expecting a fair day's work, so that you will hold the respect and confidence of your men.

I am convinced that the foremen and shift bosses of this or any other mining organization constitute the best asset of the company they are serving, provided they treat the men under their charge fairly, justly and humanely; and what can be a better asset to our company than a force of clean, satisfied, well-paid men who have the fullest confidence in the organization under which they are working and who, in case of either hard times or times of labor stress or strain, know of a certainty that the official representatives of the company are ready and willing to give to each workman a square deal?

Price of Aluminum in France

Another advance in the price of aluminum in France was made by the French Ministry of Munitions, according to *Echo des Mines* of Dec. 2, 1917. This advance was made retroactive on deliveries to works since Oct. 1 by Aluminium Français, which is charged with the distribution of the aluminum supply. Metal which had been invoiced up to that date to consumers at 4 fr. per kg. (32.7c. per lb.) is now billed at 6.40 fr. per kg. (50.9c. per lb., at present rates of exchange) for ordinary ingots, 98-99%. The usual increases were maintained for sheets and granulated metal. The benefit of this increase naturally does not go entirely to the French manufacturers, but is to a considerable extent the result of the rise, during the last two years, in the cost of coal, of labor and of raw materials, although the price of the French product remained fixed at 4 fr. The new sale price resulted from an equalization established between the price of the French metal and that of metal bought outside and fabricated in France, duty paid. In reality the rise is due especially to the necessities of war fabrication, which compelled the purchase of aluminum from foreign sources, notably from the United States.

Platinum Nuggets are more common in Russia than in the Colombian fields. The great Demidov nugget, according to Dr. George F. Kunz, in the November "Bulletin" of the Pan-American Union, is the largest in the world. being approximately 7 x 4 x 3 in. and weighing 9624 grams (21 lb. 3.46 oz. avoirdupois). It was found in the Nijni Tagil region in 1843. Another large nugget was found in the Urals in 1834 at Martinov. This weighed 8335 grams. One large Colombian nugget weighs about 800 grams.

Regulations of the U. S. Explosives Act

"The operation of the Explosives Act will doubtless cause inconvenience to persons engaged in legitimate business; it may necessitate the spending of money by bringing about changes in operating methods; but, to all loyal citizens, these hardships will be slight and temporary, and if we all coöperate in making it an efficient law, disloyalty will suffer the penalty it deserves"—U. S. Bureau of Mines.

IN THE *Journal* of Nov. 24, 1917, a summary of the Explosives Act was given. Regulations governing the act have been issued by the United States Bureau of Mines, and those that are of interest to the mining industry follow:

The purpose of the law is: To prevent disloyal persons from procuring explosives or their ingredients and to keep explosives or their ingredients out of the hands of persons who will not protect them carefully enough to prevent them from being stolen or used for unlawful purposes. Manufacturers, vendors, and others should satisfy themselves as to the loyalty and responsibility of persons to whom they sell explosives. Licensors have been instructed to refuse to issue a license to any person not known to them to be loyal and responsible unless recommended by reputable citizens of the community.

Commodities for which licenses are required include: Ammonium nitrate, blasting powder, blasting caps, all classes of percussion caps, chlorate powders, detonating fuse or cordeau detonant, detonators, dynamites, blasting machines, electric blasting caps, fuse of all varieties, permissible explosives and squibs. Explosives ingredients include nitrates and nitric acid, as well as a number of other chemical compounds not of pertinent interest. Exceptions are made when any of the commodities are sold or issued by licensed foremen to workmen under them.

Kinds of Licenses

The licenses issued are: (A) Manufacturer's license—Must be obtained by every person manufacturing explosives and listed ingredients, and permits the purchase, possession and sale of such substances by the manufacturer. These licenses are issued only by the Bureau of Mines, Washington, D. C. (B) Vendor's license—Must be obtained by every person receiving or purchasing explosives and listed ingredients for sale to others, and permits their possession for this purpose. This license is not required by foremen for sale and issuance to his workmen. These licenses are issued by all local licensing agents. (C) Purchaser's license—Must be obtained by every person receiving or purchasing explosives or listed ingredients for use, and permits their possession and use, but does not authorize the holders to sell or issue to others, except through a licensed foreman. This license is not required by workmen when sale or issuance to them is made by a licensed foreman. These licenses are issued by all local licensing agents. (D) Foreman's license—Must be obtained by every foreman, etc., who purchases, or receives from his employer, explosives or listed ingredients, for sale or issuance to workmen under him. These licenses are issued by all local licensing agents. (E) Exporter's license—Must be obtained by every person exporting explosives or listed ingredients. These licenses are issued only by the Bureau of Mines, Washington, D. C. (F) Importer's license—Must be obtained by every person importing explosives or listed ingredients. These licenses are issued only by the Bureau of Mines, Washington, D. C. (G) Analyst's, educator's, inventor's and investigator's license—Must be obtained by every person purchasing, manufacturing, possessing, testing or disposing of explosives and listed ingredients for the purpose indicated by the license name. These licenses are issued by all local licensing agents.

General Rulings on Licenses

Licenses issued by local licensing agents are good only in the state in which they are issued. A license will not be issued to an applicant under 21 years of age; except that a purchaser's license may be issued to such an applicant when he is regularly engaged in mining, agriculture, or other work requiring the use of explosives and when he is personally qualified to use explosives, and when he presents a written statement from his employer to that effect. This will not prevent the issuance of a purchaser's license to a person under 21 years of age who may be engaged in his own business, provided that such applicant presents convincing evidence to that effect. A foreman's license will not be issued to an applicant under 21 years of age.

An applicant who is not a native-born citizen and who claims citizenship must produce his certificate of naturalization or those of his parents. If unable to do this, he should produce satisfactory secondary evidence of citizenship, in the form of affidavits, supported, if necessary, by affidavits of other persons, setting forth all the facts upon which he bases his claim. None of the above licenses releases their possessors from the necessity of obtaining such other licenses as may be required under state laws or local ordinances pertaining to explosives or ingredients.

How to Obtain Licenses

Although an explosives license can be obtained at any place in the state in which the explosives or ingredients are to be sold or used, it is necessary that the applicant be known to the licensing agent or properly identified by him. Consequently it is advisable to make application to the nearest licensing agent, not necessarily in the applicant's home county, but at the most convenient place. The applicant must appear in person before the licensing agent, and previous to doing so he should prepare a statement of the amount of explosives and ingredients purchased, disposed of, or used by him during the last six months, and an estimate of the amount he will require for 12 months to come. Before filling in his application blank the applicant should read the law with care, paying especial attention to Section 12. (Sec. 12 refers to the application for license, the information required of the licensee, the fee, records to be kept by licensing agents, etc.)

Firms, associations, societies and corporations desiring a license for purchasing or vending explosives, or educational institutions applying for the analyst's, investigator's or educator's license, may apply through a properly qualified representative, and the license shall be made out in the name of the firm, association, society, corporation or institution, but a foreman's license shall be issued upon presentation of the foreman in person and shall be issued to the foreman in person, as foreman of the designated individual, firm, association, society or corporation. A corporation employee applying for the license for a corporation should present proper credentials to show his official capacity.

In the case of an applicant for an analyst's, chemist's and investigator's license, if the applicant is a person and not an institution, such person must be identified and endorsed in writing by two reputable citizens of the community known to the licensing agent, and the oath of the applicant must be taken in the presence of his endorsers.

Having read these instructions, examined the application and determined which class of license is necessary, the applicant should proceed as follows: (1) Fill out the application form (either in the presence of the licensing agent or at any convenient place). (2) Swear to the correctness of the statements in the application. (3) Pay a fee of 25c. to the licensing agent (this includes the fee for the oath). (4) Receive the license of the proper class. (5) Receive instructions regarding the duties of a person holding an explosives license. (6) Receive instructions as to records which must be kept. (7) Receive instructions regarding the reporting of explosions and fires, occurring in mines, quarries, factories, warehouses, magazines, houses, cars, boats, conveyances and all places in which explosives or ingredients are manufactured, stored or used.

If a license is refused to an applicant he may appeal from the decision of the licensing agent to the Council of National Defense, Washington, D. C., and this appeal must be made within 30 days of the refusal of license. Any person requiring certified copies of his license may obtain them by sending photographic or photostatic copies of the original license, printed on dull-finished paper, to the Director, Bureau of Mines, Washington, D. C., or by appearing before the agent of original issue and producing the license and paying a fee of 25 cents.

How to Obtain Licenses from the Bureau of Mines

Applications for manufacturer's, exporter's and importer's licenses and for other licenses required by manufacturers, exporters and importers should be obtained from the

Director of the Bureau of Mines, Washington, D. C. Blanks for such applications may be obtained from the Director, Bureau of Mines, or from the State Explosives Inspector in each state. Departments, bureaus, etc., of the United States Government and their individual employees may apply for and receive licenses either from a local licensing agent or from the Director, Bureau of Mines. The Army and Navy are the only Federal bodies exempted from licensing under the law. Appeal from refusal of license by the Director, Bureau of Mines, lies through the Council of National Defense, Washington, D. C., and must be made within 30 days of the refusal of license.

Use, Protection and Lapse of Licenses

A license is not transferable and may be used only by the person to whom it has been issued. If a licensee dies, or leaves the service of an employer for whose service the license was procured, the license becomes void and should be returned to the original licensing agent. It is the duty of a person, company, etc., to return to the licensing agent the licenses issued to foremen who have left the employ of the said person. Each license bears a number and must be protected and preserved by the licensee, so that he may be identified at any time when he desires to purchase, vend, issue or use explosives. In the event the license is lost or destroyed, a new license may be issued upon application to the original licensing agent, but only upon satisfactory evidence that the facts are as claimed. Another application form must be filled out and additional fee of 25c. paid.

Every person authorized to sell or issue, and in the case of analysts and investigators, to dispose of explosives, shall keep a complete itemized record showing when and to whom the explosives are sold, given, bartered or to whom or how otherwise disposed of. This record shall be sworn to and furnished to the Director of the Bureau of Mines, or his authorized representatives, whenever requested. Theft of or misuse of explosives and other violations of the law and all explosions and fires occurring in buildings, plants, mines, etc., where explosives are manufactured, stored, used or sold, shall be reported at once to the United States Explosives Inspector, to the proper local authorities and to the Bureau of Mines, Washington, D. C. All such occurrences involving the theft of 100 lb. or over of explosives, or the serious injury or death of one or more persons, or property damage of $1000 or more, shall be reported at once by telegram, at Government rate. Licenses must be exhibited upon request to any peace officer, Federal or state, or to any representative of the Bureau of Mines.

It is the duty of every licensee to prevent explosives sold or issued to him from coming into the hands of disloyal or incompetent persons; to keep explosives in a suitable magazine securely locked (see rules for storage) and to protect his magazines and define and post his premises with conspicuous signs on which are displayed the words, *"Explosives—Keep Off!"*

Every holder of a license is appealed to as a loyal citizen to coöperate in the enforcement of this law. Great assistance can be given by licensees through their seeing that magazines are in a safe condition, that unused explosives are returned to magazine, that careless and disloyal persons are not permitted to obtain or use explosives and that dangerous practices are discontinued.

Rules for Industries Using Explosives

Every owner or operator of a mine, quarry or other industry using explosives or ingredients will require: (1) A purchaser's license, when explosives are bought for use only by his employees, and for delivery to them at the mine or quarry. (2) Or a vendor's license, where explosives are bought for resale even in part, for use away from the mine or quarry.

Such owner or operator, when licensed as a vendor, shall be governed by the rules of the United States Bureau of Mines, to which vendors of explosives are subject; except that in selling explosives to his own employees at and for use on the premises under the control of such vendor he shall be governed solely by the following rules for their distribution: Every owner or operator of a mine, quarry or other work shall require all employees who are charged with the custody or distribution of explosives to become duly licensed. No unlicensed employee shall issue or distribute explosives. Employers desiring foreman's license issued to their employees shall certify to the licensing agent that the applicant is over 21 years of age, that he is known to such owner, operator or person in charge, and in his opinion the applicant is a proper person to whom the license may be issued. Before certifying to the character and qualification of an employee, the owner must satisfy himself as to his employee's character and responsibility.

The premises upon which each magazine is located must be marked *"Explosives—Keep Off!"* The magazine shall be in charge of one person and at all times kept securely locked, except when explosives are being put into storage in it or issued from it. A complete record must be kept of all explosives issued or returned and the name of licensee issuing or receiving them. If there is more than one magazine at the mine, quarry or on the work, separate records must be kept of each. Daily reports must be made to the office of the owner, operator or superintendent and compiled into a general record, as directed by the Director of the Bureau of Mines.

A daily inventory must be taken of the amount and kind of explosives remaining in each magazine and reported to the office of the owner, operator or superintendent, where a daily balance should be struck to determine whether any explosives have been lost or stolen. If it is found that any explosives have been lost or stolen, the person obtaining such information shall promptly notify the person in charge of the mine or other operation, and the nearest local officer. If there are a series of such losses or if more than 10 lb. are lost within the period of a week, the person in charge shall without delay notify the State Inspector of Explosives and wire the Director of the Bureau of Mines, Government rate, collect.

Only one licensed person should be in charge of a magazine or magazines and issue explosives during one shift. When going off shift the records should be checked, the stock jointly counted, checked and receipted for by the proper licensee of the succeeding shift. No explosives shall be issued to an employee of a mine, quarry, or other work except upon a written requisition signed by a licensed foreman or other authorized person. Such authorized person shall use reasonable intelligence to see that the full quantity of explosives in each case has been properly used or the unused portion returned to the magazine from which it was taken, or placed in a safe, locked box located in a position designated by the foreman. In transferring explosives from one magazine to another, the magazine keeper issuing the explosives should obtain the receipt of the magazine keeper who received the explosives.

Any employee who fails to use in a proper manner all explosives issued to him or return the unused portion to the magazine from which he received them, or place in a safe, locked box located in a position designated by the foreman, shall be guilty of a violation of the act under the authority of which these rules are issued and subject to prosecution therefor. This rule and the one next following must be read and explained to each employee whose duties may require him to use or transport explosives, and copies must be posted conspicuously upon the premises where explosives are used or stored.

Should it come to the knowledge of any person that any employee of the operator or owner of any quarry or mine has unlawfully removed explosives from the place where he is employed, such person shall immediately report such knowledge to the local authorities, to the State Explosives Inspector and by wire to the Director, Bureau of Mines, Washington, at Government rate, collect; and should he fail to do so he shall be deemed to have violated the act under the authority of which this rule has been made. A company operating several mines in the same state will require only one purchaser's or vendor's license, but must provide each of its officers with local licenses or with a certified copy of the original license. If a company operates mines in two or more states, a license of the proper class must be obtained in each state in which operations are carried on.

Suggestions

It is suggested that in mines or quarries where explosives are sold or issued by licensed foremen, a sufficient number of such foremen be provided to insure against operations being interrupted by sickness, absence, etc. At mines or quarries where explosives are not sold or issued to miners on the premises and where in consequence of this each miner must have a purchaser's license, it might be well to arrange with the nearest licensing agent to station himself at certain times at some convenient place, at or near the mines, to issue licenses; thus avoiding loss of time by large numbers of workmen who might otherwise be required to travel some distance in order to secure licenses. Ignorance of the law as to its effect on aliens may result in considerable confusion, and it is essential that every precaution be taken to avoid any violation of the law, which might result in reduction of output. It is consequently important that owners and operators coöperate to the end that their employees may fully understand the requirements of the law and comply therewith. Since licensing agents and vendors are required to satisfy themselves as to the responsibility

and loyalty of applicants and purchasers, owners and operators should lend any necessary assistance to their employees, to the end that if they are deserving they will not encounter difficulties because of their being unknown. Emphasis is placed on the fact that all forms of fuse, squibs, caps and detonators are classed as explosives under the law.

ADDITIONAL RULES

Where explosives are issued or sold to miners and quarrymen by licensed foremen at the mine or quarry, no license is required. Explosives so received must not be taken to any place not necessary in the pursuit of the business of the employer, and any unused portion must be returned to the foreman or placed in a safe, locked box, located in a position designated by the foreman. When explosives, fuse, squibs, caps or detonators are purchased away from the mine or quarry, each person so purchasing must have a purchaser's license, and this license must be shown when purchasing. Every responsible and loyal miner or quarryman is entitled to a license when such is necessary in the pursuit of his business, even though he may not be a citizen of the United States, provided that he is not a citizen or subject of a country which is at war with the United States or of a country which is allied with an enemy of the United States, and provided, further, that he be otherwise qualified under the law.

A prospector who uses explosives will require a purchaser's license. Under this license explosives must be used exclusively by the purchaser. If a prospector wishes to sell or issue explosives to other persons, he must obtain a vendor's or foreman's license and must keep a record of the sale or issuance, as provided in Section 9 of the law.

Contractors will be guided by the foregoing rules, especially those referring to quarries, mines, etc. A contractor may purchase explosives from a foreman licensed as an employee of another person, provided only that such explosives are used on the premises covered by the foreman's license under which they are purchased.

STORAGE OF EXPLOSIVES AND INGREDIENTS

All ingredients of explosives must be stored in safely locked buildings, or they must at all times be otherwise protected against theft. All explosives to the extent of 25 lb. or less may be stored in strongly constructed wooden boxes, which must be kept securely locked at all times except when being filled or emptied, and which should, whenever possible, be placed in a securely locked building. All explosives, except when in process of manufacture, when stored in quantities greater than 25 lb., must be kept in magazines which are properly constructed, safely located and securely locked or otherwise protected against theft.

The United States Explosives Inspector in each state, working in coöperation with his advisory committee, shall have the right to inspect all places where explosives or ingredients are stored, and to require the making of whatever changes in construction, location or safeguarding may be necessary for the proper protection of the contents and of surrounding property. Guards may be ordered placed, temporarily or permanently, at any magazine. Appeal may be made from any decision of the U. S. Inspector, to the Director, Bureau of Mines, Washington, D. C.

Battlefield Salvage of War Metals

Iron, steel and metallic alloys, that have been showered for months on the battlegrounds of Europe, must be removed as a necessary preliminary to the resumption of peaceful pursuits, and the question arises of how the earth is to be rid of this encumbering metal, which, because of the quantity of unexploded shells and hand grenades that it contains, would form an acute danger to agricultural labors. A systematic "sweeping" of all the bombarded regions will be required, and *Le Génie Civil* mentions an interesting apparatus which, though created for this special object, can be applied to other uses, since it will indicate the presence of all metallic bodies not too deeply buried in the soil.

This "Alpha" apparatus, as it is called because of its form, will show the presence of a 75-mm. shell at a depth of 16 in. and of a grenade at somewhat less depth. The operation is based on the principle of the Hughes induction balance. A vibrated electric current furnished by a Ruhmkorff coil is transmitted to two identical but separated exploring coils, causing respectively an inductive em.f. in two secondary coils which are in juxtaposition with them. These secondary coils are connected in opposition in the circuit of two telephone receivers. The two pairs of coils, comprising each a primary coil and a secondary coil, are theoretically identical. The inductive em.f. should therefore maintain a constant equilibrium and the receivers should transmit no sound. This is not usually the case, however, because dissymmetry always exists in the coils which must be corrected by a regulator. When this has been accomplished, if one approaches a metallic mass with one pair of coils the inductive conditions of these coils will be changed and the telephone will sound.

In the Alpha device, of which M. Chanoit was the designer, the four exploring coils are arranged in pairs around two horizontal wooden disks, two feet in diameter, suspended at the ends of two wooden arms fixed at an angle of 45°, and joined by a cross-piece. The centers of the disks are about five feet apart. The regulator is placed at the apex of the two arms. It comprises two small inclosed coils. Of these the exterior coil is fixed and in series with the primary circuit; the interior coil, inserted in the secondary circuit, can be turned 180° in such a way that the angle of the two coils may vary 90° in either direction. This instrument has already been used in connection with water service in locating the plates covering taps in places where these have been covered with earth and their exact position is uncertain. Whether the contrivance can be so improved as to be of use in mineral regions or to operate at greater depths remains for the future to show.

Test for Iron and Steel Pipe

In establishing the identity of iron and steel pipe, as used in buildings, the following test for determining the presence of manganese in the sample has been used, according to the A. M. Byers Co., of Pittsburgh, Penn., manufacturers of wrought-iron pipe:

Place in a porcelain dish, preferably a small porcelain crucible, a clean, bright drilling or some filings of the metal to be tested, about the size of a pinhead; add six drops of pure nitric acid, heat, add two drops of silver-nitrate solution, then one crystal of ammonium persulphate not greater than one-eighth inch in diameter. Warm the solution but do not let it boil. If the metal is steel, a pink color will begin to develop and at this point it should be removed from the source of heat, when a decided red coloration will result. If no coloration develops, but a small amount of dark residue remains in the dish, the metal is wrought iron. Care should be taken at all times to test only clean drillings and to keep dirt or foreign matter out of the dish. If a small thimble size crucible is used a match will supply sufficient heat for the purpose.

Manganese, in the process of steel manufacture, has to be added to the molten metal in order to make it possible to roll and weld it into pipe, while wrought iron requires no such manganese addition and therefore usually contains only a trace of this metal. Wherever it is possible to obtain samples, the manganese test can be supplemented by the crushing test, revealing the bright crystalline fracture of steel or the dull gray, fibrous fracture of wrought iron.

F. W. Matthiessen

F. W. MATTHIESSEN died at his home in La Salle, Ill., Feb. 11, 1918. He was born in 1835, in Germany, and was in his 83rd year. Simple democratic and unostentatious, Mr. Matthiessen played a large part in business, civic and social activities. He was one of the pioneers in the zinc smelting and rolling industry in the United States.

Educated in Germany and a graduate in mining engineering from the Freiberg School of Mines, Mr. Matthiessen formed a fast friendship with Edward C. Hegeler, a fellow student at Freiberg. How they came to America and established themselves is best told in the words of Mr. Matthiessen:

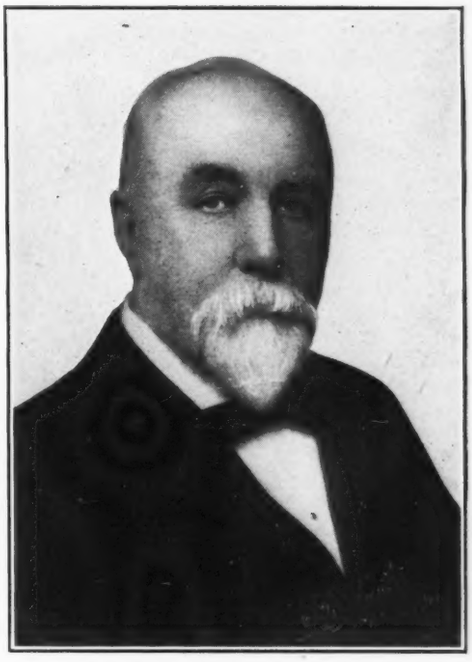
"Mr. Hegeler finished his studies in the spring of 1856, but did some important surveying in the mines of Freiberg after that. I had gone to Heidelberg for the summer. We met again in the fall of 1856 and traveled together through various mining districts of Germany, Belgium and England. Thence we sailed on a steamer for the United States, landing in Boston, immediately thereafter going to New York. In the latter city we learned that at Friedensville, near Bethlehem, in Lehigh County, Penn., attempts had been made to make zinc from the ore deposits found at that place. The ore was a fine silicate, but all attempts to produce zinc from it had failed. We were aware that success would be difficult to attain, but Mr. Hegeler looked on it as an excellent opportunity to test his skill, and I would have undertaken anything with him as a co-worker.

"We were successful and we made some metal. This was all done at our own expense. After attaining our object, we found that the company had not sufficiently recovered from the panic of the year before to furnish the necessary funds to properly equip a smelter, in addition to their works for the manufacture of white zinc. We did not feel inclined to invest our money further, since we would have been dependent on a company owning one mine only. We considered that the ore deposits would not stand the additional drain for metal making, being already taxed to supply the paint works.

"We heard about the discovery of zinc ore in the West and concluded to ascertain what chances there might be out West. We had learned of the existence of zinc ore in Southeastern Missouri and in Wisconsin. On our way West we stopped for a few months at Pittsburgh, that being the great manufacturing center, believing that by so doing we might get acquainted with American necessities and American business methods. Then we went and explored the mines in Southeastern Missouri. We made investigations with a view to establishing, perhaps, a smelter in the coal region of East St. Louis. Our experiments with the ore were satisfactory, but we found difficulties in our way on account of political conditions. We could do nothing there. This was in the spring of 1858.

"We then turned our attention to the zinc mines of Wisconsin, and were given great encouragement. This was also true when we came to La Salle, the closest field to these ore mines, with the object of establishing a smelter here. Especially did the late Alexander Campbell encourage us in our enterprise, obtaining for us the necessary real estate and also a contract with the Illinois Central R.R. We located near the Central tracks and built the first furnace a little north of the present furnaces. Mr. Hegeler had examined the fire clay in St. Louis and had ascertained that it was suitable to our needs. He bought the necessary fire brick in St. Louis and had it shipped by boat to La Salle. And we started to build the factory.

"The first shovelful of dirt was turned Dec. 24, 1858. We had a furnace running successfully when the Civil War broke out. There being no sale for spelter after the outbreak of hostilities, we ceased temporarily, but commenced operation again when in 1862 or 1863 a lively demand for zinc arose in the manufacture of arms and cartridges. During the cessation of manufacturing, we had been making experiments, so that when we started again we did so with decidedly improved methods. Our means were limited and we were very careful in our expenditures. We spent no money that was not absolutely necessary."



F. W. MATTHIESSEN

The enterprise thus begun under such humble circumstances grew rapidly, and at the end of the Civil War a zinc-rolling mill was added. In 1871 the firm of Matthiessen & Hegeler was incorporated. The mining of coal on their property was begun in 1874, and in 1881 a sulphuric-acid plant was added to the zinc smeltery. Under the guidance of the two men the smeltery of the Matthiessen & Hegeler Zinc Co. became famous for its advanced metallurgical practice.

The virility and broad interests of F. W. Matthiessen are shown by the variety of enterprises in which he was an important power. The first street railroad in La Salle, the Western Clock Co., and the La Salle Machine and Tool Co. were representative of a few of the interests that owed their success to his organizing and managerial ability. He was mayor of La Salle for 10

years and proved a capable and efficient executive. He took great pride in his community, and numerous benefactions, many of them of an eminently practical nature, bear testimony to the wisdom of his judgment.

Mr. Matthiessen was married to Fannie Clara Moeller in 1864 at Mineral Point, Wis. Mrs. Matthiessen died a few years ago at the home in La Salle. There were five children—Otto, Emma, Eda, Adele and F. W., Jr. Otto died in boyhood and Emma, who later was the wife of Dr. Philip S. Chanecellor, passed away a few years after her marriage. Eda is the wife of Henry Matthiessen; Adele the wife of Captain George P. Blow.

Fraternally, Mr. Matthiessen had few connections. He was a member of the American Institute of Mining Engineers, and as far as is known that was his only affiliation.

Proposed Process for Extracting Potash from British Feldspars

E. A. Ashcroft suggests the immediate extraction of potash from Scottish feldspar, in a paper entitled "A Neglected Chemical Reaction and an Available Source of Potash," read[1] before the Institution of Mining and Metallury. Mr. Ashcroft was assisted in the experimental development of the proposed process by H. Livingstone Sulman. No claim of an original discovery is made, but rather the adaptation of a known reaction to a commercial problem. The original article and its discussion cover over 40 pages; hence it will be possible to mention briefly only the salient features.

If potash feldspar be crushed to 100 mesh and mixed with an equal weight of pure dry sodium chloride, and then heated to 900°-1000° C. for two hours, out of contact with air or moisture, the following reaction takes place:

$$2NaCl + K_2O.Al_2O_3(SiO_2)_6 = Na_2O.Al_2O_3(SiO_2)_6 + 2KCl.$$

The reaction is reversible, and its commercial applicability will depend upon nice adjustment of mixture, temperature and time. When properly conducted, the product consists of a finely divided insoluble sodium feldspar and freely soluble sodium and potassium chloride. In laboratory experiments, the extraction from a feldspar containing 10% K_2O exceeded 85%. There was no loss by volatilization, and the weights of the products corresponded to the equation given. Experiments were conducted in closed porcelain, nickel and iron retorts, and as long as air and moisture were carefully excluded none of the retorts was attacked in the least.

In 1913 E. Bassett took out a patent in the United States based on this reaction, but its failure in commercial application may be due to the fact that Bassett claimed that air must be present, as well as to the fact that he did not recognize it as an equilibrium reaction. Working under Bassett's specifications, Ashcroft found that the recovery was small, losses were high and there was a rapid destruction of the retorts.

As the result of numerous experiments, it was found that the best results were secured when the feldspar, crushed to 100 mesh, was mixed with an equal weight of salt and subjected to a temperature of 1000° C. for two hours. Under these conditions an extraction of 86% of the potash was obtained. Treating the same mixture at the same temperature in an open retort resulted in high volatilization losses and a much lower percentage of soluble potash. Experiment also showed that, in the presence of an excess of potassium chloride, a soda feldspar was attacked, producing soluble soda salts; hence care must be used in order to avoid a reversal of the desired reaction. The recovery of the potassium chloride from the leaching water was accomplished by simply crystallizing out the sodium chloride, the more soluble potash salt remaining in solution.

As a means of practically carrying out this method, vertical retorts were tried with marked success. The feldspar was mixed with only 20% of salt, the remaining salt being placed on top of the charge; after an hour's heating 40% of the salt had percolated through the mass and passed out of the perforated bottom, carrying with it the greater part of the potash, and indicating even better results than were obtained in the laboratory retorts. As this feature is still a matter of further experiment, it is suggested that for immediate results it would be advisable to use a standard bench of large D-shaped gas retorts, eight retorts to the panel and each panel supplied by its own producer. The material to be operated upon would be fed into the retorts in suitably constructed iron boats, passing them in at one end and out at the other after remaining a sufficient time at the desired temperature. A small stream of producer gas would be used to replace any air leaking into the retort. Ten panels of such retorts would produce 50 tons of potassium chloride of 80% purity per day.

The estimated pre-war costs for the process in northern Scotland, where it is proposed to install the process, were: Quarrying, 2s. (48c.); crushing, 1s. (24c.); boats for retorts, 1s. (24c.); heating, upkeep and labor on retorts, 5s. ($1.21); crystallizing, 1s. (24c.); new salt, 2s. (48c.); total, 12s. ($2.91) per ton of feldspar treated, or £6 ($29.16) per ton of 80% muriate produced. Adding £1 ($4.86) for overhead charges and contingencies, makes a total of £7 (about $33) per ton of product in normal times. No credit is given for any byproduct, though it is quite possible, in a favored locality, that the soda feldspar formed in the reaction would have commercial value, as it is used in the manufacture of certain glass and porcelains.

While the foregoing may present nothing unusual to those who have been studying methods for the commercial extraction of potash from feldspars in the United States, it adds another possible direction to research and may suggest the elements of a process applicable to localities where feldspar, salt and fuel may be brought together at small cost.

[1]Bulletins 159 and 160, I. M. M.

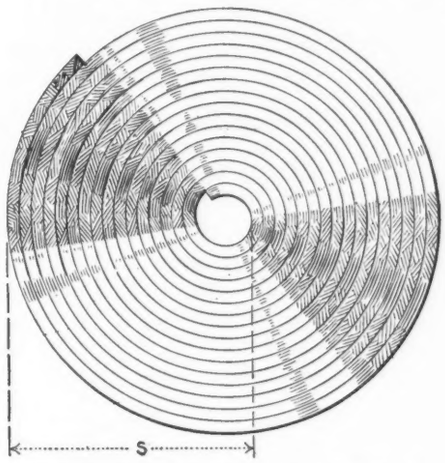
Available Supply of Arsenic in 1917 amounted to 9787 tons in the United States, according to U. S. Geological Survey. The production of arsenic in 1917, as estimated from the known production for eleven months of four companies operating seven plants, was 5826 short tons, valued as $1,300,000, compared with 5986 short tons valued at $555,187 in 1916. During 1917 the American Metal Co., through its Mexican subsidiary, resumed production in its smeltery at Mapimi, Mexico, and the Chipman Chemical Co. reopened the old arsenic plant at Brinton, Va. Preparations were also made for recovering the arsenic from a large amount of accumulated flue dust at Great Falls, Montana.

Details of Milling and Smelting

Computing Length of Belt in Rolls*

BY W. F. SCHAPHORST†

Last year I published a chart showing a method of determining the length of rolled-up belts by simply laying a straight-edge across the chart. It attracted considerable attention and a number of readers questioned its accuracy, thinking that it was not reliable because it required only one dimension, "S", as shown in the sketch herewith. I received many letters asking if the



COILED BELT SHOWING FACTOR S

thickness of the belt didn't make any difference? The thickness of the belt is immaterial. In case it is desired, the formula is

$$L = 0.2618\ NS$$

where

L = Length of belt in feet;
N = Number of turns;
S = Distance shown in the sketch in inches.

For large rolls of belt this formula will be found more accurate than the chart because of the fact that by using the chart the point of intersection of the line must be estimated. Thus it is possible to make an error of several feet in, for example, a 500-ft. roll. Such an error would not be tolerated in most instances, but, nevertheless, the chart will be found handy for estimating lengths when taking inventory, etc.

Effect of Mouthpieces on Flow of Water Through Submerged Pipe

The loss of head in the flow of water through a submerged short pipe to which a mouthpiece is attached has been the subject of an investigation by the Engineering Experiment Station at the University of Illinois, Urbana, Ill., and the results obtained by the experiments conducted, together with the conclusions drawn, have been published in a recent bulletin issued by the station. The experiments involved the use of a cast-iron pipe 22½ in. long and 6 in. diam., bored to a smooth surface. Cast-iron conical mouthpieces of different lengths and angles were employed in the tests.

The experiments showed that as applying to conditions likely to be met in engineering practice, the value for the head lost at the entrance to an inward-projecting pipe (that is, without entrance mouthpiece and not flush with wall of the reservoir) is 0.62 of the velocity head in the pipe $\left(0.62\frac{v^2}{2g}\right)$ instead of $0.93\frac{v^2}{2g}$, as usually assumed. To put it in another form, the coefficient of discharge for a submerged short pipe with an inward-projecting entrance is 0.785 instead of 0.72, as given in nearly all books on hydraulics. Further, the lost head at the entrance to a pipe having a flush or square entrance is 0.56 of the velocity head in the pipe $\left(0.56\frac{v^2}{2g}\right)$ instead of $0.49\frac{v^2}{2g}$, as usually assumed. In other words, the coefficient of discharge for a submerged short pipe with a flush entrance is 0.80 instead of 0.82, as given by nearly all authorities. The loss of head resulting from the flow of water through a submerged short pipe when a conical mouthpiece is attached to the entrance end may be as low as 0.165 of the velocity head in the pipe $\left(0.165\frac{v^2}{2g}\right)$ if the mouthpiece has a total angle of convergence between 30 and 60° and an area of ratio of end sections between 1 to 2 and 1 to 4 or somewhat greater. In other words, the coefficient of discharge for a submerged short pipe with an entrance mouthpiece as specified above is 0.915. The loss of head which occurs when water flows through a submerged short pipe having an entrance mouthpiece varies but little with the angle of the mouthpiece if the total angle of convergence is between 20 and 90° and if the area ratio is between 1 to 2 and 1 to 4 or somewhat more. The loss of head for any mouthpiece within this range would be approximately 0.20 of the velocity head in the pipe $\left(0.20\frac{v^2}{2g}\right)$. There is, therefore, little advantage to be gained by making an entrance mouthpiece longer than corresponding to an area ratio of 1 to 2. Thus, an entrance mouthpiece with a total angle of convergence of 90° and the length of which is only 0.2 of the diameter of the pipe gives approximately $0.20\frac{v^2}{2g}$ for the loss of head. The amount of velocity head recovered by a conical mouthpiece when attached to the dicharge end of a submerged short pipe depends largely upon the angle of divergence of the mouthpiece, but comparatively little upon the length of the mouthpiece. This is true for lengths greater than that corresponding to an area ratio of 1 to 2 and for total angles of divergence of 10° or more. The amount of velocity head recovered de-

*Copyright, 1917, by W. F. Schaphorst.
†Engineer, Woolworth Building, New York

creases rather rapidly as the angle of divergence increases from a total angle of 10 to 40°. At or near 40° the amount of velocity head recovered rather abruptly falls to approximately zero. A conical discharge mouthpiece having a total angle of divergence of 10° and an area ratio of 1 to 2, when attached to a submerged short pipe, will recover 0.435 of the velocity head in the pipe, which is 58% of the theoretical amount possible of recovery. The amount of velocity head recovered by a diverging or discharge mouthpiece when attached to a submerged short pipe is considerably more when a converging or entrance mouthpiece is also attached than it is when the entrance end of the short pipe is simply inward-projecting (no mouthpiece attached). This excess in the velocity head recovered diminishes rather rapidly as the angle of the discharge mouthpiece increases, and it becomes zero for a discharge mouthpiece having a total angle of divergence of approximately 40°. This increase in the velocity head recovered is probably due to the effect of smooth flow in the pipe as the water approaches the discharge mouthpiece. The smooth flow allows the mouthpiece to recover more of the velocity head in the pipe than when a more turbulent flow exists; this increase amounts to as much as 33% in the case of the discharge mouthpiece having a total angle of divergence of 10° and an area ratio of 1 to 2.

Hygiene for Lead Workers

Suggestions for the benefit of the health of lead workers in the plant of the U. S. Metals Refining Co., at East Chicago, Ind., are given by Dr. H. C. Ernst, assistant plant physician, in the *Ax-I-Dent-Ax*, the company's "safety" paper.

Tobacco chewing is particularly a bad habit for lead workers. They carry the "quid" in a dirty pocket, or handle it with soiled fingers and thus convey lead dust or its salts to the mouth, and that way acquire systemic poisoning.

In lead works, the employees should brush the teeth before eating. Besides the systemic poisoning resulting from pyorrhea, carrious teeth and gingivitis, the poor condition of the mouth impairs the appetite and digestion and lessens the workman's efficiency.

The workman should take a full hot bath at least twice a weak or oftener when the work is of such a nature where there is excessive sweating. If the work involves exposure to irritant dust or fumes, the body should be sponged with warm water and well rubbed each night before retiring. In this way the skin can be kept free from eczema or dermatitis and a more restful sleep induced. Workers exposed to metal fumes, especially those of lead, should be accorded facilities for shower bathing before returning to their homes. At meal time and before returning home, in all dusty trades the workman should be allowed at least 10 min. for thorough washing of the hands and face, and among the lead workers the use of nail-brushes also is to be emphasized.

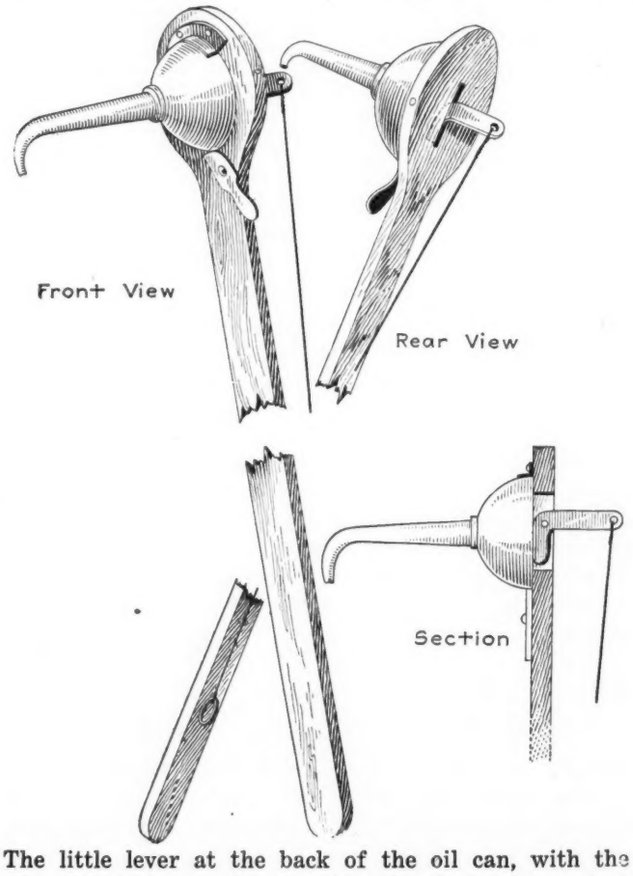
For the protection of the mouth and also in some instances for the nose against irritant dusts, which are liable to produce ulceration, a douche and gargle should frequently be used of warm normal salt or saturated boric acid solution. The nose could be protected further by greasing the interior of the nostrils with lard or vaseline. Acid vapors tend rapidly to erode the enamel of the teeth. In order to counteract its effects, the mouth should be rinsed frequently with an alkaline solution, and the teeth should be cleansed twice a day with a simple tooth paste or castile soap.

Close fiting goggles should be used where irritant dusts are liable to enter the eyes, or where irritant fumes or gases obtain, and the eyes should be bathed on quitting work with saturated solution of boric acid.

Eye shields, or goggles, made of such material as mica, wire glass, wire mesh, celluloid, etc., either plain or colored, should be worn by metal grinders, stonecutters and all those who are liable to have fine sharp particles injure the eyes. When a foreign body is lodged in the corner of the eye, a fellow workman is usually asked to remove it, which he often does with a dirty toothpick or straw, thereby setting up an inflammation which is often serious. Instead of this the workman should endeavor to float it out with boric-acid solution or a drop of sterilized oil, and, failing in doing so, only an expert should be allowed to remove the foreign body from the eye.

Extension for an Oil Can

Much of the energy expended in climbing a ladder to oil countershafts, lineshafts, etc., can be saved by the use of a simple device described by William Forray in *Power* and shown in the accompanying illustration.



The little lever at the back of the oil can, with the wire attached and with the ring placed at a convenient position on the handle, is for the purpose of pressing the bottom of the oil can. Of course this rig cannot be used to oil loose pulleys and the like, but will be found useful in a great many places.

The Assayer and Chemist

Improved Method of Sulphur Analysis

By F. G. Hawley*

Sulphur in ores and furnace products is usually determined gravimetrically, the customary procedure being to oxidize the sulphur to a sulphate, and then to precipitate it as barium sulphate and weigh. There are numerous modifications of this method, differing in the manner of oxidizing. Some commonly used employ oxidation with nitric acid and potassium chlorate or with aqua regia. These methods give satisfactory results with ores that are easily oxidized, such as those in which the principal sulphide is iron pyrites. However, it is difficult to oxidize the sulphur completely in mattes and calcines as well as in ores that contain much copper or zinc sulphide. In analyzing such material, much of the sulphur is liberated in the elemental form, fusing into small globules that can be oxidized but slowly and with difficulty. Under these conditions, it will usually be found that the results will be low, owing to volatilization loss. For such samples oxidization either by fusion or sintering will usually give good results, but as these methods are laborious and generally require a blank to determine the sulphur contained in the flux, most chemists object to them for routine work.

New Method Employs Vigorous Oxidation Agents

Some time ago I worked out a modification of the nitric acid and chlorate method by the use of which the sulphur in almost any kind of material can be oxidized easily and completely in a few minutes. This method has been in daily use for some time in several of the larger laboratories of the Southwest and has given satisfactory results. It is as follows: Weigh 0.5 to 1 gram of the sample into a 400 c.c. Griffin beaker, cover with a watch glass, add 10 c.c. of a 20% solution of $NaClO_3$ in water, and 7 to 15 drops of a mixture of equal parts of bromine and glacial acetic acid, which should be kept in a dropping bottle. Add 10 c.c. of HNO_3 nearly saturated with $KClO_3$ and shake until sample and solution are mixed. If the sulphur content is high it may be advisable to place the beaker in a cooling trough for a few minutes. In two or three minutes, or as soon as no unoxidized sulphur can be seen, place the beaker on the hot plate and evaporate carefully to dryness. Cool, add 5 c.c. of 60 HCl and again evaporate to dryness; take up with 10 c.c. of 60% HCl, heat until everything possible is dissolved, dilute to 150 c.c., neutralize with NH_4OH adding 10 c.c. excess of the latter.

If lead is present, add about one gram of ammonium carbonate also. Heat to boiling and boil one minute. Filter through a 15 cm. filter paper and wash 6 or 7 times. Heat the filtrate to boiling and boil off most of the ammonia; neutralize with HCl, adding 2 to 3 c.c. excess of the acid. Add a 10% solution of $BaCl_2$, drop by drop, until 3 to 5 c.c. have been used and then run in at once about 10 c.c. more. Boil 10 minutes, remove, let settle, filter, ignite and weigh as $BaSO_4$.

If the sample contains less than 1% of sulphur, it is better to evaporate to a bulk of 100 c.c. or less, to use a smaller excess of HCl, to boil longer and to let settle over night. The method can be shortened by making a stock solution of HNO_3, water and $NaClO_3$ and by adding 20 c.c. of it all at once to the assay, but I think the former procedure more accurate. In analyzing an ore containing barite by this method, the sulphur in the latter would not be included in the results, but it is usually not desired.

Formation of Sulphur Masses Makes Oxidation Difficult to Complete

A study of the action of ordinary concentrated nitric acid of 1.42 sp.gr. on sulphides will show that it is of a two-fold nature; first it oxidizes and combines with the metallic portion to form a nitrate, and then, in a slower and less vigorous manner, it oxidizes the sulphur to SO_3. When the oxidation of the sulphur takes place less rapidly than the solution of the metal, the sulphur is left as fine particles of elemental sulphur floating around in the acid. Enough heat is usually generated in the reaction to melt it or at least to make it soft and sticky so that the particles coalesce in larger masses. The increase in size and temperature of these flakes of sulphur renders them much more difficult to oxidize. Long contact with strong oxidizing agents will usually get most of the sulphur in solution, but generally some loss will occur from volatilization.

The chlorates are much stronger oxidizing agents than nitric acid, and their presence in the acid has a tendency to lessen the amount of sulphur that escapes oxidation. By diluting the nitric acid with a solution of $NaClO_3$ in water, the action at first is much less vigorous and, as the water absorbs considerable heat, the temperature is kept low enough to prevent any liberated sulphur from melting. The sulphur thus remains in a finely divided state and can be easily oxidized by the chlorate and bromine.

Sodium Chlorate More Soluble Than Potassium Chlorate

The advantage of using a solution of $NaClO_3$ instead of $KClO_3$ is that the former salt is much more soluble. Cold water will dissolve only about 6% of $KClO_3$ while it will dissolve nearly its own weight of $NaClO_3$. However, when it is desired to make a solution of chlorate in strong nitric acid, potassium chlorate has the advantage of keeping better, as sodium chlorate begins to decompose in a short time.

Bromine is an even more efficient oxidizing agent than chlorate. The chief objections to its use are its disagreeable fumes and its high cost. When dissolved in acetic acid it does not volatilize nearly as rapidly as

*Chief chemist, International Smelting Co., Miami, Ariz.

the pure bromine and the fumes usually so much in evidence are reduced to a minimum. A dropping bottle is an ideal container for the bromine solution. By its use the exact amount needed can be safely and quickly delivered. If only the amount recommended be used the cost will be trifling. For ores consisting principally of iron pyrites, the chlorate is sufficient to insure complete oxidation and the bromine may be dispensed with, but for those containing copper or zinc sulphides and for matte it is better to use the bromine.

Ferric Hydrate Retains Litile Sulphate if Rightly Precipitated

Some chemists prefer to precipitate the SO_3 in the presence of the ferric chloride, rather than to remove the iron by precipitating with ammonia, fearing that the ferric hydroxide will retain some sulphate. My experience is that if the solution is not too hot when the iron is precipitated and a sufficient excess of ammonia is present, there is little tendency for the ferric hydroxide to retain sulphates. If there is an insufficient excess of ammonia present, and especially if a large amount of aluminum or copper salts is also present, the precipitated hydroxide will retain a little sulphate, but it can be almost completely washed out with a warm 25% solution of ammonia. When it is properly precipitated and washed carefully so as to prevent lumps from forming that might retain some sulphate mechanically, the hydroxide will never retain more than 0.04% to 0.07% of sulphur. To prevent the formation of lumps while washing the hydroxide, direct the jet of water in such a way that it stirs the precipitate thoroughly, taking care not to let the precipitate drain so long that it begins to pack down. Some chemists think that the presence of copper in the solution in which the SO_3 is being precipitated has a distributing effect. Numerous experiments made here seem to prove that when present in any ordinary amount it has no noticeable effect.

Method Compares Favorably with Others

Many experiments have been made to test the accuracy of this method for sulphur and to compare its results with other methods. The tests have been satisfactory, and, as the results were all quite similar, but one of the sets of experiments will be given here. These analyses were made on a sample of matte containing about 42% Cu and 30% Fe. The following results were obtained:

Method 1—Oxidized by fusion with 5 grams of Na_2CO_3 and 0.7 gram KNO_3 in a platinum dish, leached with water, filtered, acidified with HCl and precipitated in the usual way. The sulphur found was 25.62, 25.65, 25.65 and 25.67 per cent.

Method 2—Oxidized by sintering in a muffle with 4 grams ZnO and 1 gram Na_2CO_3 in a platinum dish, leached with water and finished as in Method 1. The sulphur found was 25.47, 25.55, 25.55 and 25.68%.

Method 3—Oxidized by the Allen and Bishop method with Br, KBr, and HNO_3; reduced solution by powdered aluminum, filtered and precipitated sulphur. The sulphur found was 25.55 and 25.55 per cent.

Method 4—The method I have described was used. The sulphur found was 25.50, 25.54, 25.60, 25.60 and 25.52 per cent.

Method 5—Oxidized by means of 15 c.c. of a saturated solution of $KClO_3$ inHNO_3, more $KClO_3$ being added after action began. The iron was separated by ammonia. The sulphur found was 24.50, 24.90, 24.68 and 24.15 per cent.

Method 6—Oxidized in the same way as in No. 5, but pure HNO_3 was added first and then crystals of $KClO_3$. The sulphur found was 24.04, 23.85, 23.32 and 23.18%.

Globules of sulphur were formed to a large extent in Methods 5 and 6, but disappeared before the samples had evaporated to dryness. Tests by the aqua regia method indicated less than 20% of sulphur.

Determination of Zinc

The following method of determining zinc has been found useful by J. W. Springer, who describes it in *Zeit. f. angew. Chem., 1917* (republished in condensed form in *Journ. Soc. Chem. Ind.*):

Two to five grams of the ore is heated in a covered beaker with 20-25 c.c. of concentrated hydrochloric acid until the hydrogen sulphide is driven off; 10-25 c.c. of nitric acid is now added and the heating is continued until complete solution is accomplished. The contents of the beaker are evaporated to dryness and the evaporation is repeated after moistening the residue with hydrochloric acid. After expelling the last traces of nitric acid the residue is taken up with 20-50 c.c. of hydrochloric acid and is diluted to 200 or 400 c.c. and boiled.

Hydrogen sulphide is now passed through the hot solution until it cools; the mixture is made up to 250 or 500 c.c., well-shaken, and filtered; 50 c.c. of the filtrate is treated with bromine water and heated until the solution has become clear; after which the iron and manganese are preciptated by adding 25 c.c. of ammonia solution and the liquid is again boiled. The zinc is now titrated with potassium ferrocyanide in this hot solution. The volume of the solution should be approximately the same as that used for the check test which is carried out with 0.25 gram of chemically pure zinc, 4-5 c.c. of hydrochloric acid and 20 c.c. of ammonia solution. The method is a modification of that originally proposed by L. Blum in *Zeit. anal. Chem.*, 1892, 60, where it is given in detail.

Estimation of Silicon in Ferrosilicon

To determine the amount of silicon in high-grade ferrosilicon, the following method is given by H. G. Martin, in *Chemist Analyst:* Grind the material in an agate mortar and decompose 0.25 gram by fusing in a nickel crucible with 4 grams of sodium peroxide. Leach out with hot water into a casserole, acidify with hydrochloric acid, evaporate to dryness and bake 30 min. at 110° C. Take up with water and hydrochloric acid, boil and filter. Make the filtrate strongly ammoniacal, boil and filter. Ignite the precipitate in a platinum crucible at a low temperature, to get rid of the paper; fuse in 15 to 20 times its weight of potassium bisulphate until all iron is dissolved in the melt. Cool, leach out with hot water and a little HCl, boil and filter. This last residue is the portion of the silica which failed of dehydration in the baking process. Place it and the main portion of the silica, previously obtained, in a clean platinum crucible and ignite, blasting before weighing, weigh, volatilize with sulphuric and hydrofluoric acids, ignite and weigh again. The difference between the two weights is the total silica. Calculate to silicon.

Events and Economics of the War

The entire foreign commerce of the United States, including all exports and imports without exception, was made subject to control by license after Feb. 16 by President Wilson; the step is expected to add at least 1,000,000 tons to the shipping available for troops and supplies. Following the suspension of the "heatless Monday" order in the south, similar action was taken by Fuel Administrator Garfield affecting the rest of the states in the East except in New England. Section 1 of the order as well as all freight embargoes remain operative. Sentiment in Congress has shifted on the war cabinet and munitions measures, which, it is thought, may be abandoned if a compromise can be made on the Overman bill, drawn to empower the President to reorganize the executive agencies of the Government as he may see fit. The second Urgent Deficiency bill, carrying over $1,100,000,000, was reported to the House. Striking carpenters in Eastern shipyards returned to work upon being rebuked by the President for obstructing the shipbuilding program.

In Paris, Paul Bolo "Pasha" was sentenced to death as a traitor. The Ukraine, acting independently of the rest of Russia and in the midst of civil war, signed a treaty of peace with the Central Powers; the truce between the latter and Russia ended on Feb. 18; Bolshevik leaders stated they will make neither peace nor war with the Teutons. Eight small British craft were sunk by German destroyers in Dover Strait.

Stettinius' Role in War Department as Reorganized

The rôle that Edward R. Stettinius, of New York, will play in the reorganization of the War Department was more clearly defined in the following statement recently made by Secretary Baker:

"The function of Mr. Stettinius will be largely that of a surveyor of the industrial field and an accelerator of war supplies. He is to be largely instrumental in maintaining an even flow of production to the purchasing agencies of the War Department. It is within his province to keep track of the capacity and production of contractors. If there are changes in the requirements of the American expeditionary forces, orders for these changes must be passed on down the line by Mr. Stettinius, so that the production may be in accord with the demand. Mr. Stettinius will also watch closely the transportation and shipping situation, in order that the production and deliveries of war materials may proceed properly.

"In other words, Mr. Stettinius, a business man and purchasing agent of vast experience, may figuratively be called the 'surveying eye' for the Director of Purchases and Supplies, who is a military officer and assistant to the Chief of Staff. Mr. Stettinius will endeavor to mobilize industry for the war needs of the department, and when a certain article is required he will know where that article may be readily obtained and the price at which it may be obtained."

Secretary Baker also disclosed the plans of the department with respect to the personnel in charge of the five newly formed divisions of the General Staff. These will be:

Executive division, to be in charge of a permanent executive assistant to the Chief of Staff, but now in charge of Brig. Gen. W. S. Graves, of the General Staff.

War plans division, to be headed by Brig. Gen. P. D. Lockridge, president of the Army War College; but in his absence to be in charge of Col. D. W. Ketcham.

Purchase and supply division, to be in charge of Brig. Gen. Palmer E. Pierce, who will have associated with him Edward R. Stettinius, of New York, as Surveyor of Supplies and Purchases.

Storage and traffic division, to be in charge of Maj. Gen. George W. Goethals, the Quartermaster General of the Army.

Army operations division, to be in charge of a permanent director of operations; Brig. Gen. H. Jervey is acting for the General Staff in this capacity at present.

Steel After the War

The United States may find a keen competitor in Europe in the manufacture of steel after the war, instead of a consumer which will take, as has been hopefully stated so often, millions of tons of American steel for rebuilding purposes. Great Britain, Canada, Germany and other countries are making steel today in greater quantities and more economically and efficiently than ever before. There is no reason to suppose that Europe will not show a similar increased capacity for producing commercial steel after the war is over.

A prominent steel manufacturer recently expressed himself on the subject, saying:

"The European countries may be in debt to the extent of, say, about $100,000,000,000. Great Britian, France, Russia and Belgium will owe this country billions of dollars. Is it possible that anyone believes that Europe will start in by still further increasing its obligations to this country through the purchase of steel and other products? I guess not.

"Europe will seek to expand its markets, and the United States, as the richest nation in the world, will be the great objective point, or dumping ground, if you wish to put it that way. And how defenseless we will be, with cost per ton of steel produced now above the normal selling price of the same steel previous to the war! With our high wages and in the absence of a substantial protective tariff, a serious situation may confront us.

"A world-wide readjustment is the great problem that must be dealt with after the war—a readjustment of labor, prices, finance, ideas and theories. It is time that preparations were made to meet future trade changes. We should not deceive ourselves by believing that Europe will be our big customer after the war. Europe is likely to be our poorest customer. Europe may be a seller, not a buyer."

McAdoo Bans Unnecessary Building

Capital and credit should not be used for unnecessary building operations during the war. This is the opinion of Secretary McAdoo, who said:

"Because of the interest of the Treasury Department in the conservation of capital and credit during the period of the war, I have received several inquiries as to whether building operations of one kind and another should be discouraged. With regard to plans for public buildings under the control of this department, I have stopped letting contracts except in cases where they were absolutely necessary.

"Home building is an excellent thing in normal times, but at present, unless there is a real shortage of houses for war workers, I strongly advise that materials, valuable labor, and credit be not utilized for this purpose. Whether homes should be built should be determined strictly by the urgency of the need."

Garfield Suspends Fuel Order

The order providing for heatless and workless Mondays until Mar. 25 in the states east of the Mississippi excepting New England, where the regulation is still in force, was suspended on Feb. 13 by Fuel Administrator Garfield, the action being concurred in by Director General of Railroads McAdoo. It was emphasized that the order was simply suspended and not rescinded. Should weather conditions cause a new transportation and coal crisis, it is possible that the order will again become generally effective. In the meantime, railroad embargoes ordered by the Director General of Railroads will remain in force until there is further improvement in the whole situation. This decision followed the recent edict suspending the order in the southern states.

Section 1 of the order, prescribing the preference to be shown by dealers in delivering coal, remains in force. Dr. Garfield said in the course of his statement:

"The order contemplated fuel restrictions on 14 days during January, February, and March. The restrictions have been in effect eight days. Conditions today warrant the conclusion that with the continued enforcement of the preferential delivery of coal under Section 1 of the order of Jan. 17, and continued transportation improvement, further restrictions on the consumption of fuel will not be necessary."

Overproduction May Stop Industry

Danger of industrial overproduction, which may swamp railroads and transatlantic shipping facilities, causing embargoes and temporary factory shutdowns, was pointed out to the Senate Military Committee recently by H. L. Gantt, a production engineer of the Army Ordnance Bureau and the Shipping Board. He emphasized the need of some coördination of control. Divided responsibility in Government work, he declared, has been responsible for much confusion.

"This machine is built wrong," said Gantt. "It's all right for a nice, smooth asphalt road, but not for the very rocky road we're going over. The trouble is that the people who have built the machine are largely lawyers, financiers, and school teachers—good ones, but their experience has been in dealing with words. They are not accustomed to handle things—only words."

Danger of factory overproduction, and even of absolute stoppage of industry, also was expressed by Dr. Herman Schneider, dean of the Cincinnati Engineering University, in charge of labor problems for the Ordnance Bureau.

"I fear we are running into fewer working days per week for labor," he said, "with the cost of living increasing—a rather serious situation. Either there must be a reduction in the number of working days or a control of production."

Russian Mines Commandeered

The mines and smelting works of the Kyshtim Corporation, Ltd., a British company operating in the southern district of the Ural Mountains, in Russia, were recently declared confiscated by a Bolshevik decree and made national property. The company published a statement to this effect on Jan. 22. The property involved comprises 1,406,700 acres, of which iron mines, smelting works and gold and copper deposits cover 189,000 acres. The principal mines are the Amerikansky, Koniukhoff, Smirnoff, Ivanoff, and Tissoff. The company is capitalized at £1,260,000. Its statement says in part:

This is in accordance with the Bolshevik program, that all property and industry must be made national. In the case of the Kyshtim mining works the reason given is that the administration have refused to accept the control of the workmen's committees. If this control by the committees were accepted it would have involved the handing over to the workmen of full control over the management, and the only responsibility remaining for the administration would be that of finance, under which conditions it is obvious it would be impossible to operate. The directors are not able to estimate the operative value of such a decree, nor have they yet heard that any steps have been taken to put it in force.

The directors wish to state that, from reliable information received from Petrograd, transport in the country is totally disorganized; it is practically impossible to obtain fuel, materials, wages or food. A stoppage of operations was in any case inevitable; the decree regarding the nationalization of banks has prevented the company from continuing to finance the operations of the properties. Further, it is at present impossible to transfer money from this country to the Russian banks.

In a word, Russia today is in a condition, as is well known, of absolute anarchy, and the operation of the Kyshtim properties is practically impossible. It is the opinion of the directors and managers in Russia that the present confiscation decree may make things easier when order is restored, as the responsibility for the troubles which are almost certain to result from the present conditions will fall entirely on the Bolshevik usurpers of the company's rights and properties.

The company has entered a formal protest through the British Embassy, at Petrograd, based on the fact that the Kyshtim business has been built up by British capital and that all shares are British owned.

Western Petroleum Supervisor Named

Prof. D. M. Folsom, head of Stanford University, was recently appointed by Mark L. Requa to supervise the production and distribution of petroleum in certain western states, as well as Alaska and Hawaii. His territory includes California, Washington, Oregon, Idaho, Utah, Nevada and Arizona. Professor Folsom announced that there will be no compulsory licensing of oil producers at present, as this would require the Fuel Administration to become immediately responsible for operation and production. A system of friendly cooperation, rather, will be practiced.

"It will be necessary, however," Professor Folsom stated, "for all companies to pool their cars and tank ships to prevent shortages and embarrassment in deliveries." No limit is to be placed on fuel-oil consumption so long as storage conditions remain as they are.

Profiteering in Germany

When the *Frankfurter Zeitung* recently attacked the German war profiteers, especially the Krupps and other munition makers, for "making a good thing out of the war" and heaping up gain at the expense of the nation as a whole, a cry of indignation immediately went up from the organs of the Pan-German and iron and steel capitalists, and the Frankfort paper was accused of dealing in generalities, and not citing facts to prove its contention. This caused the paper to print figures showing that 37 munition plants and allied works, with a combined capital of $400,000,000, cleared in the last year 75% more than they earned in the year 1913-14—that is, in round figures $87,500,000, as against $50,000,000. The same concerns increased their dividends, on the average, from 8.2% to 13.9%, though several of them doubled their dividends. In the two years last reported these 37 companies made such large profits that they could afford to write off an amount equivalent to 40% of their entire stock capital.

In commenting on these data, the *Zeitung*, as quoted in the London press, said: "We see that business is flourishing. It is flourishing just now, probably, more than ever, because the War Office is paying the large works (not the small ones) prices which deserve the closest attention of the Treasury Department."

As evidence of the far-reaching plans of German industry for the future, it is noted that the Mannesmann firm, of Westphalia, is about to increase its capital from $3,500,000 to $21,500,000.

Americanization in Steel Plants

The Valley Americanization Committee, representing the industrial organizations in the boroughs of Sharpsville, Sharon, Farrell and Wheatland, in Shenango Valley, Penn., and with an annual budget of nearly $6000 provided by the steel and iron plants of the district, has established and maintains schools for aliens in the various boroughs, and has employed a director who gives all of his time to Americanization work. Each plant employing foreign-born men has taken an alien census and appointed a representative who acts as the medium between such aliens and the committee. A card is being filled out for every non-English-speaking employee, who either pledges himself to enroll in the night school or states his reasons for not so doing.

The committee has also organized a series of "nationality" meetings, at which plant superintendents and local officials address the men and emphasize the night school facilities, naturalization procedure, and Americanization. After a year's efforts to educate foreign-born workmen, the committee points out that besides preparing the men for citizenship, the work has beneficial results in the plants. It saves time in giving orders and directions of work; it tends toward greater safety by teaching men to read signs and understand the work; it makes orders more explicit; its airs the dissatisfaction of the men; and it cuts down labor turnover.

Work of War Credits Board

The War Credits Board, created to pass upon advances of funds to contractors engaged on Government work, has approved such payments aggregating approximately $150,000,000. These advances, made under authority of an act of Congress, have stimulated the production of war materials, and both large and small contractors have availed themselves of the system.

The board was created by the Secretary of War with the following members: Samuel McRoberts, vice president of the National City Bank of New York, now a colonel in the Ordnance Department, National Army; M. W. Thompson, financial expert and accounting lawyer, of New York City, now lieutenant colonel in the Signal Corps, U. S. Army, and Edward Clifford, an investment banker, of Chicago, now lieutenant colonel, Quartermaster Corps, National Army. A number of attorneys, bankers, and accountants, including Donald M. Liddell, engineer and accountant, were called in as assistants to the board in considering the great number of applications immediately made for advance payments on Government contracts. The law permits advances not exceeding 30% of the contract price for supplies, such payments to be amply secured.

"Many manufacturers, on account of delays caused by railroad congestion, etc.," says a statement made by the board, "used up all their capital, borrowed all they could from their banks, and still did not have the money necessary to finish their supplies and make deliveries to the Government so as to get payment for them. In some instances they were on the verge of closing down their plants because of their inability to get the cash to meet their payrolls.

"By authorizing advance payments promptly the board has relieved all these contractors, who, instead of spending their time trying to find money, are now enabled to devote themselves entirely to the business of producing war requirements."

Big Drop in 1917 Building

The record of buildings erected in the United States for 1917 reflects the swift readjustment of our national resources consequent upon the war. In 101 principal cities of the United States for 1917 the building permits received by the *American Contractor*, New York, show a total of $631,746,722, compared with $889,884,679 for 1916, a decrease of 29%. The total number of permits issued in these 101 cities was 198,968, as against 258,484 for 1916, a decrease of 23%. The average cost of buildings erected in 1917 was less than that erected in 1916, not because of reduced costs but because of a greater percentage of small residences built, the need for workmen's homes having become acute. A few cities, 29 in fact, show a gain for the year. These do not include any of the first class, and the gains are due mainly to special causes.

War Credits extended to foreign governments by the Treasury since the United States entered the war are as follows, according to a statement authorized by the Department: Great Britain, $2,045,000,000; France, $1,285,000,000; Italy, $500,000,000; Russia, $325,000,000; Belgium, $77,400,000, and Serbia, $4,000,000. The total is $4,236,400,000.

Industrial News from Washington

By Paul Wooton, Special Correspondent

All Foreign Trade Under License

From an industrial standpoint, the most important recent event was the issuance by the President of his import and export proclamations, making the entire foreign commerce of the United States subject to control by license. This action is declared to be necessary to place the "full force of our industrial strength behind our offensive against the enemy." With regard to the importation of raw materials which will be governed by regulations drawn by the Bureau of Imports of the War Trade Board, the following statement is made:

Every effort will be made to administer these regulations with the slightest possible detriment to legitimate business interests, but when it is considered that the transmittal of a few pounds of rubber or copper to Germany may cost the lives of scores of our men at the front, and that each day's supply of wool, or food, or money, to the enemy means another day's war, with its accompanying toll of lives, the very thought of hesitancy or weakness is inconceivable. The policy will be "safety first" for our soldiers, regardless of every other consideration. Persons and firms in this country as well as abroad, who before our entrance into the war had little sympathy with the war-time commercial safeguards of the Allies, must be taught that these are now matters of the first importance to this country, and violators of present restrictions need expect no favors, regardless of how important such individuals or firms may be in the business world. The time has come when all must realize that the war is not limited to combating the enemy on the battlefields of France, but must be carried into our everyday transactions of life, and that our business practices must be remolded, where necessary, to meet existing conditions.

No anxiety need be felt by importers that there will be any serious restriction of the importation of necessary articles, if the transaction does not involve dealing with an enemy or ally of an enemy, or otherwise giving him aid or comfort. If the importer endeavors diligently and in a spirit of coöperation to comply with the requirements of the War Trade Board, no loss, and but slight inconvenience, need be anticipated.

While the orders cover "all articles of any kind whatsoever," all metals, minerals, mineral oils, ores and all derivatives and manufactures thereof, along with numerous other more important articles of commerce, are mentioned specifically.

The plan of making all imports and exports subject to license is expected to simplify rather than to complicate the procedure which has been necessary since Nov. 28, when licenses were required for certain articles only. There now is no question as to what requires a license, and it is believed that much uncertainty and delay will be avoided as a consequence. So far as imports are concerned, it has been recognized for many months that control over distribution of raw materials is necessary.

Time Extended for Filing Tax Returns

Extension to Apr. 1 of the time for filing returns for income and war excess-profits taxes was announced recently by the Commissioner of Internal Revenue in the following statement:

Because of unavoidable delay in the preparation of forms and regulations for the war excess-profits tax, and hence in the preparation of the related forms and regulations for returns for the income and war income taxes, and in order to afford taxpayers a necessary period for the preparation of returns after receiving the forms and regulations, the time for filing returns due after Oct. 16, 1917, and on or before Mar. 1, 1918, pursuant to the act of Sept. 8, 1916, and the act of Oct. 3, 1917, for income, war income and war excess-profits taxes, whether they are to be made on the basis of the calendar year or of a fiscal year ended during the year 1917, is hereby extended to Apr. 1, 1918. So far as this extension applies to the returns of corporations to be made on the basis of a fiscal year other than the calendar year, it amends the provisions of T. D. 2561, as amended by T. D. 2615 and 2633.

Assay Commission Named

An assay commission has been appointed by the President consisting of the following members: Representative William A. Ashbrook, Johnstown, Ohio; Will H. Rounds, Sioux Falls, S. D.; John L. McNeill, Durango, Colo.; W. P. Morris, New Hampshire; L. V. Bassett, Rock Mount, Salem, Ill.; Samuel Newhouse, Salt Lake City, Utah; Calvin Page, Portsmouth, N. C.; A. C. Weiss, Duluth, Minn.; J. H. O'Neil, Boston, Mass.; L. W. Nieman, Milwaukee, Wis.; Martin H. Glynn, Albany, N. Y.; Roy W. Keehn, Chicago, Ill.; S. B. Amidon, Wichita, Kan.; Robert P. Oldham, Seattle, Wash.; Kenneth M. Simpson, San Francisco, Calif.; Dr. George F. Kunz, New York; Dr. Marcus Benjamin, Washington; Louis A. Fischer, Washington, and Dr. W. P. Hillebrand, Bureau of Standards, Washington.

Mineral-Control Bill Opposed

A substitute measure for the Mineral-Control Bill, which was drafted by the War Minerals Committee, probably will be drawn up by Senator Pittman, of Nevada, and Representative Foster, the chairman of the House Committee on Mines and Mining. Senator Pittman believes that the proposed bill is unnecessarily broad in its scope and too indefinite in its effect. He thinks a bill can be worked out which would accomplish all the control the Government officials have in mind and at the same time not shake the confidence of the mining operator. Senator Pittman has discussed the bill with department officials and expects to begin work on the new measure at once.

Shipment of Export Minerals Affected by Traffic Re-routing

Mineral exporters are evincing great interest in the appointment of an inter-regional traffic committee by the Director General of Railroads. Many inquiries have already reached Washington with regard to the change in routing necessary to shift traffic from the more seriously congested gateways and ports to those that are less congested. The matter of distributing traffic more advantageously has been placed in the hands of B. L. Winchell, C. F. Randolph and T. C. Powell.

American Institute of Mining Engineers

The annual meeting of the Institute convened at New York on Feb. 18, and concluded on Feb. 21 with a visit to the aviation field at Princeton, N. J. The technical papers were interesting and timely, dealing to a considerable extent with the conservation and development of materials required in the prosecution of the war. Sidney J. Jennings was elected president, and an amendment raising the requirements for membership was passed.

THE 116th meeting of the American Institute of Mining Engineers convened at the Engineering Societies Building in New York on Monday, Feb. 18, the technical sessions continuing until Thursday, when a visit to the aviation field at Princeton, N. J., was scheduled as the concluding event of the meeting. The registration on Monday morning started rather slowly, but the attendance was soon swelled by the arrival of many members who had been on trains that were slightly delayed. By Monday afternoon the registration gave promise of an attendance nearly, if not fully, as large as in normal years.

The technical papers presented were interesting and timely; in them and in the discussions the keynote was how best to conserve national resources of labor and minerals so as to render the greatest assistance in the prosecution of the war and the maintenance of proper conditions at home. The Woman's Auxiliary of the Institute, as in previous years, immediately took in charge the entertainment of the visiting ladies, besides holding several business sessions to deal with organization matters and with the war relief work which the Woman's Auxiliary has undertaken. The entertainment included visits to the art galleries of Henry C. Frick and the Hon. William A. Clark; to the Metropolitan Museum of Art; several receptions, including one at the residence of President-elect and Mrs. Sidney J. Jennings at 44 East 80th St., and a theater party to see "Chu Chin Chow." The ladies also attended on Wednesday the "Hoover" dinner and informal dance at the Hotel Biltmore and the visit to the Princeton, N. J., aviation field on Thursday. The principal excursion of technical interest was a trip through the New York subways to inspect some of the recent work and methods of holding loose ground.

The first technical sessions were those of the coal and of the nonferrous-metallurgy divisions, which were held simultaneously in the two halls on the fifth floor of the headquarters building. G. H. Clevenger acted as chairman of the metallurgical session, and the first paper, by F. R. Pyne, on the "Disadvantages of Chrome Brick in Copper Reverberatory Furnaces," evoked considerable discussion. Mr. Pyne pointed out the difficulties of metal absorption and of fluxing the chrome bats and stated that the hydraulically pressed magnesite bricks now available were preferable in most instances in copper-refining work. Prof. H. O. Hofman in the discussion pointed out that the temperatures that usually prevail in copper blast furnaces were too low to flux chromite and directed attention to the freezing-point curves of M. Simonis, showing that the eutectic mixture of chromite and kaolinite—35% of the former and 65% of the latter—freezes at Seger cone No. 15 (1435° C.). Kaolinite fuses at cone No. 35 (1770° C.) and chromite at cone No. 42 (2000° C.). The curve showed that the Mansfeld practice—which uses 23% coke and a slag containing 49.09% SiO_2, 5.58 (FeMg)O, 16.02 (CaMg)O, 16.02 Al_2O_3—might give a temperature that would flux and fuse the chromite bats. Forest Rutherford corroborated the author's statement of difficulties experienced in fluxing chrome bats and gave the results of experience at the Copper Queen works in Arizona. Chrome bricks had given satisfactory service in the blast-furnace settlers, where they lasted from two to three years. Magnesite bricks, when once heated, could not afterward be subjected to moisture, and, though tried in the reverberatory walls, had not proved so satisfactory as one course of chrome brick—to stop fluxing with silica brick below—then 18 in. of magnesite and one course of chrome brick. Difficulty was experienced when charging along the side walls instead of fettling, owing to the moisture contained in the ore, and for this practice Mr. Rutherford considered a straight silica-brick wall most satisfactory. Secretary Stoughton suggested that it would be patriotic not to use any more chrome brick than necessary, in order to conserve our supply of chromite for war needs.

Woolsey McA. Johnson's paper on the "Fine-Grinding and Porous-Briquetting of the Zinc Charge" pointed out the advantage that might be obtained through better heat conductivity and ventilation of the zinc charge. Discussion was participated in by Messrs. Ralston, Hofman, Hall and Eagles. Mr. Ralston suggested that with the expansion of flotation and the production of finer concentrates some steps, as indicated by the author, would have to be taken by the zinc smelter, or perhaps the lime treatment of raw zinc sulphide might be again used. In response to inquiry, Mr. Johnson stated that the binder used in his briquetting experiments was sludge acid from oil refining and that this binder was used in quantities varying from 10 to 12%. In the next paper, W. E. Ruder gave the results of some tests of "High-Temperature Resistance Furnaces with Ductile Molybdenum or Tungsten Resistors." The application of these furnaces was mainly in the laboratory and experimental work at high temperatures. Practically a temperature of 2500° C. could be obtained with a useful life, though temperatures up to 3350° C.—the melting point of the tungsten resistor—were possible for short periods with the vacuum type of furnace. The furnaces had been used at the General Electric works for heat treating and degassifying tungsten.

"Zinc Refining," especially that phase of it developed by the war demand for high-grade spelters, was the subject of a paper read by Leland E. Wemple. Discussion elicited the information from the author that the total net loss in refining spelter was between 6 and 7%, about 5% of which was in the first operation and the remainder in the retreatment of byproducts. The papers on "Bone-Ash Cupels," by Frederic P. Dewey, and "An Automatic Filter at Depue, Ill," by G. S. Brooks and L. G. Duncan, were read by title only.

At the coal session, the most interesting papers were those of R. E. Hobart, on "The Economy of Electricity Over Steam for Power Purposes in and About the Mines," and G. S. Rice's "Review of the Coal Situation of the World." Mr. Rice touched upon the wasteful methods of mining coal in this country and deprecated the fact that to get cheap coal only the best coal was taken. He expressed the hope that the day would come when by paying 10 to 25% more for our coal we would enable the mine to adopt less wasteful methods, but he intimated that this would have to be a mutual arrangement between operators and miners.

The results of experiments showing the great saving possible by complete electrification of the coal mine, to replace a steam-operated plant; then the installation of such electric plant and its complete verification of the experiment, even effecting a power saving of 50%, were interestingly shown by Mr. Hobart. In the discussion of this paper it was brought out that many of the tests to determine the advisability of a change from steam to electricity, as made by the steam engineers, were misleading, since what was wanted was not a boiler test made under ideal conditions of clean flues and boilers, expert firing and regular work, but a running test under normal conditions, the irregular work of a mine and consequent irregular firing, pumping, etc. One member emphatically stated that a regular boiler test made under ideal conditions threw no light on the matter and was practically valueless. It was brought out in the discussion that the real weakness of a steam plant was in its failure to adopt itself to irregular working, and the real strength of an electric plant was its adaptability to irregular working. With a steam plant, the boiler must be kept going night and day to keep the pressure up for any peak load. It was not practicable to drop off a boiler or put it on again; this caused a great waste of coal. The point was made that the electric installation was more flexible, and if an operation was large enough, or varied enough, to be able to avoid conflicting peak loads on the various machines, more efficient results were obtained with electricity than with steam alone. It was also suggested that the upkeep of steam engines, steam hoists, steam pumps and steam lines was very materially greater than electric installations doing the same work. One member said that their experiments showed that a 1500-kw. alternating-current plant, costing about $125,000, would replace two boiler plants of a combined capacity of 3600 hp., and would effect a net saving of $15,000 per year, with coal at $1 per ton.

The annual business meeting was held on Tuesday morning, at which time the election of officers was announced. The new officers are: President, Sidney J. Jennings; vice presidents, Henry F. Drinker, Robert M. Raymond; directors, F. G. Cottrell, Hennen Jennings, George C. Stone, Samuel A. Taylor and Arthur Thacher. The amendment providing for an increase in the standards of membership was passed, 1123 votes for, 59 opposing and 6 ballots invalid.

On Tuesday afternoon simultaneous sessions were held by the iron and steel and by the petroleum and gas division. The later sessions, the smoker on Tuesday evening and the "Hoover" dinner on Wednesday, will be reviewed at greater length in the next issue of the *Journal.*

Remember the Twenty-Seventh

"His journey of uncertainty"—thus one member of the mining regiment styles the adventure upon which he has embarked. The men of the Twenty-seventh have eagerly answered the call to join the colors. They don't know where they are going, but they are on their way, with a stopover at Camp Meade. This blithesome, devil-may-care spirit we must help them maintain. To this end the Association of the 27th Engineers (the Comfort Club) was formed. Contributions are wanted for the Association's fund, out of which may be purchased tobacco, athletic equipment, games, etc., for the men and which will be a prompt source of aid for their families if needed. Receipts to date are as follows:

Engineering and Mining Journal	$1000.00
New York Engineering Co.	1000.00
A Friend, Nov. 23	5.00
H. H.	5.00
D. E. Charlton	5.00
H. W. Hardinge	1000.00
Frank N. Spencer	5.00
W. L. Coursen	5.00
J. H. Polhemus	5.00
J. H. Janeway	10.00
Albert D. Beers	10.00
J. E. Hayes	10.00
J. A. Van Mater	25.00
L. Vogelstein & Co.	100.00
"Cuprite"	10.00
R. H. Bassett (Hanna Ore Mining Co.)	10.00
A Friend, Dec. 10	10.00
P. A. Mosman	10.00
American Zinc, Lead and Smelting Co.	100.00
J. G. H.	5.00
Daniel Guggenheim	100.00
A. H. H.	5.00
Willard S. Morse	25.00
August Heckscher	100.00
Anaconda Copper Mining Co.	1000.00
F. W. Bradley	100.00
Charles Le Vasseur	5.00
A Friend, Dec. 13	50.00
Freeland Jewett	10.00
Herman A. Wagner	5.00
Francis P. Sinn	10.00
R. C. Gosrow	5.00
D. C. Jackling	100.00
"V"	10.00
J. H. Brickenstein	5.00
E. E. Northrup	5.00
Rogers, Mayer & Ball	50.00
Denver Technical Staff, American Metal Co., Ltd.	30.00
A Friend, Jan. 9	100.00
E. B. Coolidge	10.00
J. V. N. Dorr	200.00
Pope Yeatman	50.00
W. H. Aldridge	50.00
C. E. Hart	5.00
Robert I. Kerr	5.00
Engineers of Washoe Smeltery, Anaconda Copper Mining Company	205.00
Harry C. Graham	25.00
Utah Copper, Nevada Consolidated, Ray Consolidated and Chino copper companies	1000.00
A Friend, Jan. 23	5.00
John Gillie	25.00
J. N. Houser	5.00
C. K. Lipman	50.00
Theodore Sternfeld	50.00
Clinton H. Crane	500.00
T. Wolfson	10.00
William H. Hampton	10.00
W. E. Merriss	10.00
J. Parke Channing	100.00
Miami Copper Co.	250.00
J. H. Means	10.00
C. W. Goodale	25.00
P. G. Beckett	50.00
F. R. Foraker	25.00
Charles A. Chase	25.00
E. Fleming L'Engle	5.00
Calumet & Hecla Mining Co.	250.00
H. G. Ferguson	18.00
Jay E. Van Gundy	10.00
Franklin Osborn	10.00
Oscar Lachmund	10.00
W. T. Swoyer	10.00
Interest	10.00
Total	$8068.00

Are you uncertain about subscribing to the fund? The men of the regiment are of your own kind. Some of them were working alongside of you, perhaps, only a few weeks ago. Perhaps you could not see your way clear to enlist in the regiment. Here, then, is your chance to do your bit. Make your checks payable to W. R. Ingalls, treasurer.

Editorials

Reductio ad Absurdum

TEN months ago we preached "Increase production and diminish consumption."

Washington dispatches Tuesday afternoon told of the alarm that is being felt in Administration quarters respecting the startling decrease in steel production.

It was hinted that non-essential consumption would have to be curtailed further by arbitrary proscription.

Thus we see ourselves standing on the quagmire of diminishing production, instead of on the safe ground of increasing production.

This situation is presented under the headlines of "Serious Decline in Steel Production—Delays to Progress of the War Threatened—Non-Essentials in the Way—Need of Prompt Remedial Measures—What Recent Official Figures Reveal."

This is being blamed upon the coal shortage, the railway congestion.

But the statistics for 1917, which were available within 10 days after the end of the year, showed that the production of iron had decreased as compared with 1916. The production of copper had decreased. Among the great price-fixed commodities only coal had increased, but although the tons of coal were more, there was great doubt whether the total of heat units in it were more.

The same dispatches brought the news that the Senate's Agricultural Committee had reported favorably on a bill to raise the price for the 1918 crop of wheat to $2.50 per bushel. A Senator introduced a resolution to make it $2.75. These motions follow statements that the farmers are reluctant to plant under the present $2 guarantee.

Price-fixing by Congressional legislation was bound to come. The principles of sound economics having been repudiated, we are approaching the *reductio ad absurdum*.

Some Economic Considerations

THE Treasury Department has a committee of economists, representing the chairs of Yale, Harvard, Princeton, Columbia and Colorado College, with the leadership of Prof. Irving Fisher, of Yale, which has been engaged in a study of the purchasing power of money in war time and on Feb. 10 issued its first public statement.

This committee finds that the average of wholesale commodity prices last month was 81% above that of July, 1914, while the rise in retail prices in the same period has been 57%. This confirms the opinion, not infrequently expressed, that the cost of living has not increased so much as is indicated by the common index numbers, which reflect the basic commodity prices. The individual is more concerned with retail prices, but even they enter but partly into his cost of living. Other things, such as rent and the use of public services, constitute important parts. It is doubtful if rents on the average have increased as much as 57% during the last three years, and it is well known that the charges for public services have increased but slightly in any cases, and not at all in most cases. Therefore, if the finding of Professor Fisher's committee be correct, it is certain that the present cost of living is not 1.57 times that of July, 1914, and that the actual increment is materially less than that.

However, exposition of the above subject is not the purpose of the Treasury economists' first report, which is rather to point out the evils of inflation, either of credit or currency, or both. The committee says:

> In particular we must avoid, so far as possible, *lending by borrowing*. Loans to the Government made not from savings but from borrowings will tend to increase bank credit. Further extension of bank credit will chiefly bring about a rise in commodity prices. It is therefore desirable that further loans to the Government should be made out of current savings.
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> There are two ways for us to lend money to our country. The right way is the frank and honest way of saving, by spending less or earning more. The other and wrong way is the, at first, cheap and easy, although ultimately costly and painful, way of lending the Government what we borrow from the bank. . . .
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> If I buy Government securities by giving up the purchase of a pleasure automobile, the Government can buy a military truck with the same money, and the labor and capital which would have made the pleasure car for me will make the truck for the Army instead. That is the right way.
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> The wrong method is employed if I insist upon buying that pleasure car and so can buy the Government securities only by borrowing the money at a bank. I have sacrificed nothing out of current-money income. I have simply increased the money income of the Government. . . . I give the Government my check to buy the truck, but at the same time I enter the market to prevent the Government from getting it. In short, the public, by its paper subscriptions, appears generous to its Government, but is selfishly refusing to make the actual sacrifice. . . . Thereupon the Government, in order to buy away from us what we will not otherwise surrender, bids up prices.
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> . . . . . .
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> But rising commodity prices present only one of a series of evils which will follow if we continue far on the wrong road. In the wild scramble to buy—the public competing against the Government and the producer trying to satisfy both—there is increasing difficulty in getting supplies. There occur railway congestion, car shortage, coal famine (for instance, from using up coal in non-essential industries and from using the cars needed to move it) and other dislocations.
>
> The best and quickest way of finding the right road—the road of thrift—is by reducing consumption and increasing production, by repressing non-essentials and by organizing a redirection of industry. President Wilson has well said, "It is our duty to protect our people, so far as we may, against the very serious hardships and evils which would be likely to arise out of the inflation which would be produced by vast loans." And again, "Now is the time for America to correct her unpardonable fault of wastefulness and extravagance."

With all due respect to the eminent committee of economists, may we be permitted to say that their report, which is characterized by sound sense in principle, is equally remarkable for its evasion of the cognizance of some facts, of the logical deductions from them and its own clearly enunciated principles, and its adherence to a policy of the impossible? The cardinal

point in the economic policy of the Administration has been to prevent inflation, although it was argued by many from the very beginning that inflation could not be prevented. It might be temporarily repressed, but it was bound to burst out in one way or another. Experience is fulfilling this forecast of nine months ago. Repression in one direction has developed weakness in another, necessitating a new piece of artificial patchwork, only to find that something must then be done in still another direction, and finally we see the Treasury Department itself introducing as an Administration measure what is inflation thinly disguised.

The first act of repression was price-fixing. Within the first few days of the war business said instinctively that production must be increased and consumption decreased. What it meant was that the country needed more coal, iron, copper, cotton, wheat, etc., and on the other hand should reduce its wastes and eliminate its extravagances. This was common sense and sound economics. But instead of this we have tried to reduce our wastes and extravagances by means of exhortation, which is less effective than compulsion, while, on the other hand, we view the disconcerting fact that our production has not increased. We have, indeed, witnessed railway congestion, coal famine, and dislocation of labor and other things, but it has not been inflation that has produced them. The present declaration from Washington that production must be checked and that labor must be redistributed sounds paradoxical unless it is understood what is meant, and there is a conspicuous absence of clear thinking on this subject.

What is meant is not that the production of the basic commodities should be checked; on the contrary, that kind of production has already been mischievously hampered and now needs to be speeded up. On the other hand, the production of some things has been overcontracted for, and such production does, indeed, need to be checked.

It is melancholy that an industrial and financial situation that was so brilliant a year ago has been brought into the mess that it is now, where we have some kind of a crisis staring us in the face, though we are hoping to avert it and probably will do so. There is probably no serious impairment of the fundamentals (except for the increasing inefficiency of labor and the locking up of much money). Our situation is rather like that of a regiment, splendidly equipped, that has been marched into a stone wall by its officers' failing to give the correct commands. Our estimated gross volume of business in 1917 was about $50,000,000,000, our net income about $15,000,000,000, while our war cost up to Jan. 1 was about $7,000,000,000, including loans to the Allies (which are mainly spent here). Of course, the war expenditure should simply have replaced general building, municipal improvement, etc., which has, in fact, been largely the case, but Washington has put its money into all kinds of munitioning without any clear plans, building equipment that it cannot possibly transport in any short time, building much in places whence our railway facilities are insufficient to carry it away, producing a general congestion in the main railway arteries, a dislocation of labor supply, and, in short, of many things. This is now understood, and efforts toward coördination are being made, and it is hoped to avoid a serious economic crisis. The checking of production that is now talked about means, of course, that we shall divert some of our energy and money back to domestic employment, such as repairing our railways, for the simple reason that there is no use in putting it into the manufacturing of munitions that cannot be transported before 1919, or later.

Not for one moment are we advocating inflation as being something beneficial, but the view may be entertained that a moderate inflation is better than artificial repression, which, after all, is bound to result in failure. High prices carry with them their own corrective, one of the manifestations of which is curtailment of consumption by force of circumstances, in ways that are more effective than exhortation. With repressed inflation we have experienced exactly the evils that the Treasury Committee outlines among the consequences of inflation. And even while the Treasury Committee is giving its advice, the Secretary of the Treasury is promoting a stupendous financial measure that spells deliberate credit inflation, although it is argued that this will not be dangerous if the power be wisely controlled.

Copper for Shipbuilding

AT THE present time, when so tremendous a program of shipbuilding is in progress, it is interesting to consider the quantity of copper required for this purpose alone. In the *Journal* of March 25, 1916, we published an article on this subject, to which reference may now usefully be made. The following is a quotation from that article:

> Generalizing, however, for the ordinary first-class cargo vessel having about 10,000 tons dead weight, engines of 3000 to 4000 i.hp. and speed of 12 to 14 knots, the requirement for copper and the copper content of brass, bronze, etc., ranges from about 100,000 lb. to about 200,000 lb. A ship of 10,000 tons d.w., 3000 i.hp. and 12-knot speed might be built with the lower of those figures if there were no special requirements as to copper. The upper of the two figures probably represents the maximum that would be used in a ship of this class. Judging from the data supplied by six large shipbuilding companies, the use of 150,000 lb. for a 10,000-ton ship would probably be not far away from the actual average.
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> The copper is used in the form of brass and copper tubes, condenser tubes, wire, sheet copper, propeller blades and numerous castings made from alloys containing copper. The figures that are stated represent only the quantity of copper purchased by the shipbuilders as raw copper or brass. They do not include the copper in valves, cocks, pumps and many auxiliary fittings that are purchased from other manufacturers. As for the consumption by the shipbuilder himself, the quantity is about equally divided between copper and copper in brass. For example, a concern building a 10,000-ton ship might buy 90,000 lb. of copper and 150,000 lb. of brass. Reckoning the copper content of the latter at 100,000 lb., the total purchase of copper for this ship would be 190,000 lb.

The plans for shipbuilding in the United States contemplate the provision of 6,000,000 tons in 1918. That figure may not be attained, but, assuming that it might be, there would be a consumption of about 90,000,000 lb. of copper for that purpose alone. Shipbuilding in Great Britian and other foreign countries will greatly increase that total. As to the consumption of copper in naval shipbuilding, we cannot form any idea, for no one of the governments reveals the extent of its naval construction. Ships of war require vastly more copper than do mer-

chant ships. For example, a battleship like the U. S. S. "Idaho" requires 1,500,000 to 2,000,000 lb. of copper and brass. Without any doubt, the requirements for copper in such construction, both here and in Europe, are huge.

The proposed bill for the regulation of the mining industry, which is commonly referred to as the bill for a "mineral dictatorship," is meeting with general opposition in the mining districts of the West. We understand that the sponsors for the bill have modified it so as to exclude copper, lead, zinc, and iron mining from its provisions.

The days of suspended industry in February may or may not have been costly, but it is certain that they were not so expensive as the New York dailies represented last Sunday, on the authority of the *Black Diamond*. They put the loss for eight days at $4,344,000,000, which would be $543,000,000 per day, or at the rate of $162,900,000,000 per annum, reckoning 300 days. Inasmuch as the gross volume of business in the United States in 1917 is estimated at about $50,000,000,000, there is manifestly something wrong in estimating the loss of about 8% of that sum in eight days.

BY THE WAY

The New York *Herald* says the most powerful message to the American people which has gone out from the national Capital this week was contained in testimony before the Senate Committee on Commerce, when George J. Baldwin, head of the American International Shipbuilding Co., exclaimed under cross-examination: "Let us build the ships first; then put us in jail."

The war has changed ocean routes and trade relations. Now the United States is dealing directly with the producers of raw materials. Half of the tin mined in Bolivia will be refined in this country hereafter. Germany will sell no more dyes in the United States, and the $15,000,000 yearly taken from domestic industries will remain here to the benefit of American labor and capital. American dyes are now being exported to 21 countries.

William D. Haywood, international secretary and treasurer of the I. W. W., who with 165 other members of the organization was indicted by a Federal grand jury on a charge of conspiracy and sedition, was released on bonds of $15,000 on Feb. 12. Federal Judge Landis reduced the amount of the bail from $25,000 to $15,000, despite the protest of District Attorney Clyne and Frank K. Nebeker, special assistant United States Attorney.

"This man does not want his freedom; he is holding himself out as a martyr," said Mr. Nebeker.

In pleading for the release of Haywood, Attorney George F. Wandever said:

"The freedom of Bill Haywood, regarded as a hero by his fellow members, will relieve a certain tension. It has been felt by various of the I. W. W. members and sympathizers throughout the country that justice has not been done. This, Your Honor, is not intended as a threat."

As to self-protection against fires in one's property the National Board of Fire Underwriters suggests that each individual should pledge himself as follows:

I will keep our match supply in metal boxes.

So far as I can, I will use only safety matches.

No lamps will be filled by artificial light or after dark.

Coal oil and gasoline will be kept in absolutely air-tight metal receptacles.

If I smoke, I will smoke where neither match, pipe, nor stub will endanger life or property.

I will see that every match is out before it leaves my hand.

January Pig Iron Production

Pig iron production in January, 1918, amounted to 2,411,768 tons, according to *Iron Age*, the output for the month being the smallest since June, 1915. The decrease was caused by the severe cold weather and poor transportation conditions. The table shows the production by months for the last three years.

ANTHRACITE AND COKE PIG IRON PRODUCTION
(In Long Tons)

	1917	1916	1915
January	3,150,938	3,185,121	1,601,421
February	2,645,247	3,087,212	1,674,771
March	3,251,352	3,337,691	2,063,834
April	3,334,960	3,277,768	2,116,494
May	3,417,340	3,361,073	2,263,470
June	3,270,055	3,211,588	2,380,827
July	3,342,438	3,224,513	2,562,427
August	3,247,947	3,203,713	2,779,647
September	3,133,954	3,202,366	2,852,561
October	3,303,038	3,508,849	3,125,491
November	3,205,794	3,311,811	3,037,308
December	2,882,919	3,171,087	3,302,322
Totals	38,185,982	39,032,792	29,682,566

Foreign Trade in Copper

Exports of copper from the United States in November, December and for the year 1917 are reported by the Department of Commerce as follows:

	Nov. Lb.	Dec. Lb.	Jan.-Dec. Lb.
Ore and concentrates, contents	48,740	868,037	5,790,510
Unrefined, in bars, pigs, etc	6,784,621	9,480	17,215,445
Refined, bars, etc	76,553,151	81,776,947	1,029,076,493
Old and scrap		232,833	1,183,109
Plates and sheets	2,505,643	6,786,754	42,669,943
Pipes and tubes	564,994	542,905	(a) 7,273,480
Wire, except insulated	1,617,244	4,238,198	26,880,887
Composition metal, copper chief value	4,718	26,367	(a) 1,230,910
Totals	88,079,111	94,481,521	1,131,320,777

(a) Figures cover period beginning July 1.

The weight of ore exported in December was 10,904 long tons, and of concentrates, matte and regulus, 189 long tons.

Imports of copper in November, December and for the year 1917 were as follows:

	Nov. Lb.	Dec. Lb.	Jan.-Dec. Lb.
Ore and concentrates, contents	12,344,102	16,500,020	154,698,164
Matte and regulus, etc	3,718,242	700,936	21,048,943
Unrefined, in bars, pigs, etc	20,643,329	40,701,202	355,598,036
Refined, in bars, etc	88,592	613,619	6,747,958
Old, etc., for remanufacture	186,236	107,672	17,893,594
Composition metal, copper chief value	22,407	9,221	429,702
Totals	37,002,908	58,632,670	556,416,397

Ore imported in December weighed 42,683 long tons; concentrates 11,948; matte and regulus, 695 long tons.

Personals

Have you contributed to the Association of the 27th Engineers?

H. H. Nicholson is making examinations in the Joplin district of Missouri.

Louis Cohen, mining engineer of Denver, has moved from 229 First National Bank Bldg., to 614 Ideal Building.

J. S. Lutes, general manager of mines of the Tod-Stambaugh company, on the Cuyuna Range, has left for Pasadena, California.

C. C. Conover, formerly assistant superintendent of the National Zinc Co., at Springfield, Ill., has been made superintendent.

Andrew Nesbit has returned to Oroville, Calif., after a year's absence in the Malay Peninsula, where he was engaged in tin dredging operations.

Mark R. Lamb showed colored slides and moving pictures taken along the West Coast of South America, at the New York meeting of the American Institute of Mining Engineers on Feb. 19.

Andrew J. Reeder, of Minneapolis, Minn., president of the Summit Development Co., operating the Shafter mine and other properties in the Summit mining district of Montana, recently arrived at Virginia City, Montana.

Pope Yeatman has been suggested for the chairmanship of the newly formed "Joint Information Board on Minerals and Their Derivatives." **Edson S. Bastin,** of the U. S. Geological Survey, is to be secretary of the board.

G. H. Clevenger resigned as research professor of metallurgy at Stanford University on Jan. 1, 1918, and is now engaged in directing coöperative experimental work which is being done by the U. S. Bureau of Mines, Netherlands East Indies government, Research Corporation of New York and others.

Campbell N. Watson, head of the firm of H. A. Watson & Co., ore and metal brokers, of Liverpool, England, has been gazetted by the War Office and decorated with the "D. S. O." for conspicuous gallantry and devotion to duty at a critical moment. Col. Watson has been in the trenches for three winters.

Waddill Catchings has resigned as president of the Sloss-Sheffield Steel and Iron Co., but will continue as a director of the company. Mr. Catchings recently became a partner in the banking firm of Goldman, Sachs & Co. **J. W. McQueen,** who has been first vice president of the Sloss-Sheffield company for a number of years, succeeds Mr. Catchings as president.

C. B. Lihme, of Chicago, has been elected president of the Matthiessen & Hegeler Zinc Co., to succeed F. W. Matthiessen, Jr. The directors chosen for the ensuing year were: Mary Hegeler Carus, George P. Blow, F. W. Matthiessen, Jr., Frank O. Wetmore, C. B. Lihme. The directors selected their officers as follows: C. B. Lihme, president; Mary Hegeler Carus, 1st vice president; George P. Blow, 2nd vice president; F. W. Matthiessen, Jr., secretary.

Albert W. Burch, representing the U. S. Bureau of Mines, and **E. F. Burchard,** of the U. S. Geological Survey, are about to start on a trip to Cuba, other parts of the West Indies and to Central America for the purpose of ascertaining the capacity of these countries to supply manganese ore. Mr. Burch, who was formerly general manager of the Goldfield Consolidated Mines Co., and has been established in San Francisco as a mining engineer, has joined the Bureau's staff as a volunteer.

Prof. D. M. Folsom, head of the school of mines at Stanford University, Calif., was appointed petroleum administrator for the western states on Feb. 6 by Mark L. Requa, head of the oil division of the Fuel Administration. Prof. Folsom has been serving as chairman of the petroleum committee of the state fuel administrator in California. In his new capacity he will have supervision over the production and distribution of petroleum in California, Washington, Oregon, Idaho, Utah, Nevada, Arizona, Alaska and Hawaii.

Lieut. Arthur Edgar Gerald Collins, a graduate of the Massachusetts Institute of Technology, who is well known in Denver as the son of George E. Collins, and is now serving with the Royal Engineers, British Army, has been strongly recommended for the immediate award of the Military Cross on the following record: On Nov. 20, 1917, Lieut. Collins, upon hearing that a road reconnaissance in the vicinity of Flesquieres was urgently required, voluntarily went forward after the capture of Havrincourt, knowing that the road was under heavy machine-gun and shell fire. After several unsuccessful attempts, he eventually completed a most thorough reconnaissance, at great personal risk, and succeeded in entering the western outskirts of Flesquieres, which was still in enemy hands and being attacked by British troops from the south. He was able to point out to the cavalry a way into the village through the wire. After 15 hours' continuous work, including advancing after the second wave of the attack earlier in the day, he returned to Havrincourt and helped to get guns forward over a very bad piece of ground. Lieut. Collins has consistently displayed great gallantry and fine qualities of leadership and organization under fire.

Obituary

Auguste Mathez, mining engineer, died at his home in Denver, Colo., on Feb. 4, from heart failure. He was born in Brooklyn, N. Y., in 1856, and was graduated from the Columbia School of Mines in 1877. He was first employed in California and Nevada as a mining engineer, but later returned to New York, where he engaged in the brokerage business. He later went to Colorado to take charge of the Cashier mine, in Gilpin County. Afterward, for the Guggenheim interests, he made an extended tour through the interior of China with the view of exploring its mineral resources. Other trips of similar nature took him to Australia, Central America and Mexico. Mr. Mathez was a member of the University Club of Denver and of the Engineers Club, New York.

Societies

American Society of Civil Engineers met on Feb. 20 in the Engineering Societies Bldg., New York. The construction of Camp Devens, at Ayer, Mass., was described from a contractor's standpoint from the beginning to completion by V. T. Goggin, contracting engineer.

American Society for Testing Materials will hold its 21st annual meeting on June 25-28, 1918, at the Hotel Traymore, Atlantic City, N. J. Manuscripts of papers to be presented at the meeting should be in the hands of the secretary-treasurer by Apr. 15 and as far in advance of that date as possible.

Association of Ohio Technical Societies was organized at a conference of Ohio engineering societies held at Columbus on Jan. 29. Clyde T. Morris, professor of civil engineering in Ohio State University, was elected president, and C. E. Drayer, of Cleveland, secretary. All engineering societies and branches of national societies in Ohio were represented with but one exception. A desire to bring about professional unity in the state was the main feature of the meeting. All delegates seemed to recognize that regulation by law of the practice of engineering is coming and that engineers must take part in the lawmaking themselves, to avoid being ignored.

Montana Section of American Institute of Mining Engineers held its annual meeting at the Silver Bow Club, Butte, Mont., on Feb. 1, 1918. The following officers were elected for the ensuing year: N. B. Braly, chairman; B. H. Dunshee, vice-chairman; E. B. Young, secretary-treasurer; C. D. Demond and F. W. Bacorn, executive committee. Papers were presented by Prof. C. H. Clapp on "A Comparison of the Contact Deposits of Vancouver and Adjacent Islands with Those of Arizona;" by C. D. Demond, on "Efficiency and Design of Hydraulic Classifiers" and by F. W. Bacorn on "Notes on Shaft-Sinking." James R. Evans, recently returned from Africa, entertained the meeting with an interesting account of diamond mining and elephant hunting in the Belgian Congo.

Canadian National Clay Products Association held its sixteenth annual convention on Jan. 29-30 at the Prince George Hotel, Toronto. Addresses were made by Thomas Kennedy, of Swansea, Ont., and Mayor Thomas Church, of Toronto. Among the technical papers presented and discussed were the following: "The Relation of the Economic Geologist to the Clay Industry," by Prof. N. B. Davis, Kingston, Ont.; "Kiln Construction Kinks," by W. G. Worcester, Calgary, Alta.; "Sewer-Pipe Manufacture," by F. Coleman, Hamilton, Ont.; "Refractory Material in Canada," by Joseph Keele, Ottawa; "The Application of Electric Motors in the Claymaking Industry," by Kenneth C. Burney, Hamilton, Ont.; and "Producer-Gas-Fired Dryers," by R. H. McElroy, Dayton, Ohio. Officers were elected as follows: President, Thomas Kennedy, Swansea, Ont.; vice presidents, William Brugess, Todmorden, Ont.; Ryland H. New, Hamilton, Ont.; and G. Angus German, Toronto; secretary-treasurer, Gordon C. Keith, Toronto; councillors, Charles B. Lewis, Toronto; John S. McCannell, Milton, Ont.; Walter Clark, Corunna, Ont.; T. H. Graham, Inglewood, Ont.; Charles A. Millar, Toronto; Andrew Dods, Mimico, Ont.; E. Frid, Hamilton, Ont.; and N. T. Gagnon, Montreal.

Industrial News

Asbestos Protected Metal Co., of Pittsburgh, has moved its Boston office to the State Mutual Bldg. William H. Cummings will be in charge.

Pittsburgh Wood Preserving Co., together with the Ohio Wood Preserving Co., the Michigan Wood Preserving Co., the Acme Tie Co. of Michigan, and the Century Coal Co., of which companies Grant B. Shipley is president, have moved their offices in Pittsburgh, Penn., from the Commonwealth Bldg. to more spacious quarters in the Century Building.

Metal and Thermit Corporation, recently formed through the merger of the Goldschmidt Detinning Co. and the Goldschmidt Thermit Co., is capitalized at $3,250,000. W. T. Graham has been elected president of the new concern and Daniel G. Reid a director. The concerns merged have been working under practically identical management and direction, with an entire community of interest, for two years. The new corporation takes over and will operate four different plants, located at Jersey City and Chrome, N. J.; Wyandotte, Mich., and East Chicago, Ind. The Chrome and East Chicago plants are detinning works, the Wyandotte plant manufactures liquid chlorine, and the Jersey City plant thermit products, including welding materials, carbon-free metals, alloys and pure tungsten powder. The corporation also has plants and welding shops in Pittsburgh, Chicago, San Francisco, and Toronto. General offices of the new concern are at 120 Broadway, New York.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Alumina—Process for preparing alums from clay or other similar natural compounds of aluminina. Louis L. Jackson, New York, N. Y., assignor of one-half to Odus C. Horney, New York, N. Y. (U. S. No. 1,254,229; Jan. 22, 1918.)

Aluminum — Alloy of Aluminum and Beryllium. Hugh S. Cooper, Cleveland, Ohio, assignor to the Cooper Research Co., Cleveland, Ohio. (U. S. No. 1,254,987; Jan. 29, 1918.)

Aluminum—Composition of Matter Consisting of Aluminum, Tin and Phosphorus. Frank T. Schuller, Minneapolis, Minn. (U. S. No. 1,254,854; Jan. 29, 1918.)

Concentration — Machine for Separating Gold, Silver, and the Like from Sands. Daniel Diver, Calgary, Alberta, Canada. (U. S. No. 1,254,484; Jan. 22, 1918.)

Ore Treatment—Process of Treating Ores Involving Sintering of Metal Oxides for Blast Furnace. Arthur S. Dwight, New York, N. Y. (U. S. No. 1,254,316; Jan. 22, 1918.)

Pig Lead—Lead Supply System for Pig Casting Machines. John F. Miller, Trail, B. C., Canada. (U. S. No. 1,255,103; Jan. 29, 1918.)

Pig Lead—Machine for Casting Lead Pigs. John F. Miller, Trail, B. C., Canada. (U. S. No. 1,255,102; Jan 29, 1918.)

Rock Drill. Rowland O. Pickin, Chicago, Ill. (U. S. No. 1,254,267; Jan. 22, 1918.)

Steel Process. Frederick T. Snyder, Oak Park, Ill. (U. S. No. 1,254,078; January 22, 1918.)

Zinc Smelting—Process and Apparatus for Producing Zinc and the Like in an Electric Radiation Furnace. Filip Tharaldsen, Christiania, Norway. (U. S. No. 1,255,066; Jan. 29, 1918.)

Zinc Smelting—Method or Process of Smelting Zinc Involving Chloridizing of Blue Powders. Isak Partanen, Telluride, Colo. (U. S. No. 1,254,531; Jan. 22, 1918.)

Editorial Correspondence

SAN FRANCISCO—Feb. 6

In the Comstock Mines of Nevada, ores assaying as high as $186 per ton were taken from the Union Consolidated from a vein on the 2300 level. Other assays were from $158 in the 2400 level to $30 in the 2500 level. The mine sent to the Mexican mill during the week 407 tons averaging $26.86 and 97 tons of ledge rock averaging $6.47. Ophir sent to the mill 43 cars of ore assaying $11.04 per ton, and 141 tons sampling, $10.08 per ton. Sierra Nevada developed ore on the 2500 level assaying from $4.62 to $37.36 per ton, and showing good silver content. Jacket saved 23 cars of low-grade ore from the 300 level, 250 cars from the surface tunnel; put 368 tons in mill bins and shipped one bar of bullion.

SALT LAKE CITY—Feb. 15

The Salt Lake Chemical Co., producing potash salts from the waters of Great Salt Lake at Grants, 30 to 35 miles west of Salt Lake City, is preparing to double the capacity of its plant, which at present produces four tons of potash salts daily by the Solvay process. The working forces will be increased.

The Deep Creek District, in Tooele County, has developed its first dividend paying mine in the Western Utah Copper, after a shipping period of not quite a year since the completion of the new railroad into this camp. The Western Utah Copper, shipping about 200 tons of ore daily, chiefly copper and lately some lead, since last spring, on Feb. 15 will pay in dividends $37,000, or 7½c. per share. The authorized capital stock is 500,000 shares, and about 490,000 shares are issued.

Oil Shales Investigation is being conducted by the Salt Lake station of the U. S. Bureau of Mines, on a laboratory basis in coöperation with the University of Utah; and the results of experiments with processes of extraction of oil and byproducts are to be published. The Bureau is also coöperating as far as may be in the determination of the resources of this section in this material by making superficial examinations of specimens sent in by prospectors and others to determine whether in each case there is sufficient volatile matter present to warrant complete analysis, and when the material appears of sufficient interest, submitting the names of analysts qualified to make complete determinations. In this way material of no value is eliminated. The Bureau itself is not authorized to make complete analyses.

BUTTE, MONT.—Feb. 7

The Minerals Separation vs. Butte and Superior hearing will take place on Mar. 8, before the Court of Appeals in San Francisco. The suit brought to recover damages for the use of the Minerals Separation process in the Butte and Superior mill, was decided by Federal Judge Bourquin, and the court awarded decision in favor of the Minerals Separation Company.

The Production from Butte Properties in January was only 24,500,000 lbs. of copper. This represents an increase of about 3,000,000 lbs., compared with December, and is nearly 3,000,000 lbs. less than in January, 1917, when the companies were employing about the same number of men as at present. The Butte and Superior Mining Co. milled in January 47,000 tons of ore, which is an increase of 4,000 tons compared with December, but which is 8000 tons less than a year ago, when the same number of men were employed. The East Butte company is the only concern showing an increase in production compared with a year ago. In January, 1918, the company produced 2,574,140 lbs. of copper which is approximately 74,000 lbs. more than in December and is a record in the history of the company. The facts brought out by the above figures indicate that the East Butte company has capable and experienced miners, while the other companies are compelled to put up with men who hire as miners and who manage to get by because of the lack of better men. It is known that in some of the mines there are a number of I. W. W. sympathizers, who declare that they are storing away enough money to carry them through the summer, when they will refuse to work. The agitator is active, and it is now quite common talk that April 1 is the date fixed by the I. W. W for resumption of labor strikes. Agitators are either living through funds supplied by the I. W. W. in different parts of the country, or by money supplied by German agents, who are known to be still active. These men are constantly moving about where miners congregate, preaching the doctrine of a demand for more wages and fewer working hours.

Manganese Mining in the Philipsburg district, from the beginning, has closely followed development. From the reports of geologists it seems probable that the deposits contain at least 135,000 tons of ore suitable for ferromanganese, and perhaps as much as 350,000 or 400,000 tons which under present conditions should all be marketable. The deposits are inclosed in a magnesian limestone and a partial analysis of a typical sample of the rhodocrosite ore shows that it contains 41.39% manganese, 0.22% iron and 0.24% silica. In preparing ore for shipment some of the waste is picked out by hand and the rest passed over screens to reduce the silica contents. The screenings average from 32 to 40% manganese and 20 to 28% silica, while the lump ore contains 40.5% manganese and 15% silica. Most of the ore shipped from Philipsburg contains 45% manganese, less than 2½% iron and about 15% silica, and is worth about $30 a ton, f.o.b. Philipsburg. The Philipsburg Mining Co. has installed a concentrator to treat the screenings and the large deposits of the more siliceous ores from several properties in the district.

SPOKANE, WASH.—Feb. 13

The Belcher Mine, in Republic Camp, has been bought by Frank Babcock, of Ewan, Wash., for a price of $50,000, payable in installments extended over a period of two years. The Belcher has been a producer of copper-gold ore of low grade. About 5000 ft. of work has been done. Shipments last year totaled 3000 tons. The general content of the ore has been 6% copper, $1 in gold and 40 to 50c. in silver per ton. The property was located in 1896.

Metal Mining Companies in the State benefit by a new interpretation of the industrial insurance law, which has just been announced. The commission proposed to collect 5% on payrolls for the first nine months of 1917 and 2½% for the last three months. The metal mining association protested recently, urging a uniform collection of 2½% for the year. The commission has ordered, in a letter received recently, that the 2½% rate applied from June 7, 1917. This increases the period of lower rating from three months to nearly seven months.

The Washington Water Power Co. will provide power to operate machinery in the magnesite and copper districts of Stevens County, Washington, having closed a contract with the Stevens County Light and Power Co. to provide current from its hydro-electric plant. The latter company will build its own line, and the power will be taken from the recently completed plant at Long Lake, 20 miles south of Spokane. The Washington Water Power Co. has been furnishing power for the operation of several mines in the Coeur d'Alene district for a number of years.

The Discovery of Gas in a well being sunk by the Walla Walla Oil, Gas and Pipe Line Co., in Benton County, Washington, has aroused considerable excitement. The first flow was estimated at 300,000 ft., and this has been followed by a new strike, liberating, it is estimated, 3,000,000 ft. of gas daily. The strike was made at a depth of about 600 ft. Solid basalt rock was drilled through, and when the strike was made pieces of rock were thrown as high as the top of the derrick. The company is planning considerable development as a result of the find. George A. Libby, of Tacoma, is president, and Henry B. James is general manager.

WALLACE, IDAHO—Feb. 15

The Consolidated Interstate-Callahan Mining Co.'s annual report covers the eighteen months ended Dec. 31, this being the result of changing the company's fiscal year to conform to the calendar. Summarizing the statistics, President John A. Percival points out that the operations of the last 18 months show a net profit of $2,325,876, to which is added the surplus of $806,710 as of June 30, 1916, making a total of $3,132,587. Of this there was paid during this period dividends aggregating for the period covered, $2,557,445. These dividends, with the dividends paid prior to July 1, 1916, bring the total to $6,509,860 since April 1, 1915, the date of the initial dividend payment. The ore mined was 240,858 tons, ore milled was 197,388 tons, and ore shipped was 215,992 tons. Average metal contents were: Silver, 3.97 oz. per ton; lead, 11.64%; zinc, 42.74%. Total gross value of lead and zinc, crude ore and concentrates, as sold to the smelters, $5,153,398. The average cost of mining and milling was $5.901 per ton of ore mined. Average total cost per ton of ore shipped f.o.b. mine, $14.113. The total receipts for the period were $4,179,931. Against this is charged disbursements, which include cost of production, new flotation mill and other extensive mill equipment, new electric hoist and installation, assessment work and patenting claims, building construction, acquisition of new mining property and dividends, leaving a surplus on hand Dec. 31 of $551,940.

LEAD, S. D.—Feb. 12

South Dakota Mineral Production in 1917: According to the annual report of the state mine inspector, the mines of South Dakota produced during 1917, 1,860,904 tons of gold and silver ore valued at $7,518,333. The production is apportioned as follows: Homestake, 1,679,475 tons, valued at $6,636,622.35; Trojan, 113,121 tons, $471,268,45; Golden Reward, 33,328 tons, $198,040.36; Mogul-Ofer, 35,980 tons, $187,317.39; Homelode, 450 tons, $1850; Elk Mountain, 3120 tons, $9215.66; Bismarck, 2325 tons, $3719.77; Columbia, 64 tons, $3484.07; miscellaneous, 38 tons, $6815.05. In addition, there were shipped 267 tons of tungsten concentrates and high-grade ore, which had a total value of $320,009. Most of this material was taken from the Homestake, although the Wasp No. 2 made one shipment. Several small shipments were credited to the southern mills. There were shipped 324 tons of lead-silver ores, valued at $6695, from the Galena and Spokane districts; 1281 tons of lithia ore, valued at $25,620, from the Keystone district; 321 tons of mica, valued at $9259, from Pringle and Berne; 80 tons of copper ore from Keystone and Rochford, having a value of $1887; 22 tons of tin concentrates were shipped from Hill City, having a value of $8200. Pyrite, manganese, gypsum, kaolinite, coal, limestone and structural materials were also recovered, and the total for all productions is placed at $8,201,448. The bullion recovered shows a slight decrease over the previous year, and the same is true of the tons treated. The total number of underground employees shows a large decrease over 1916. There were seven fatal accidents in 1917.

JOPLIN, MO.—Feb. 14

Business Men of Seneca, Mo., are boosting mining activity in a novel way. They have appointed a committee from the Commercial Club to obtain leases from farmers and land owners, and then advertise for and otherwise seek mining men to take leases and develop them. No royalty is charged and the plan is meeting with some success.

Attempt to Obtain a Protective Tariff on all zinc ore is to be made once more by the sheet-ground operators of this district. At a meeting held at Webb City, a committee of 10 men was appointed to investigate possibilities and make a trip to Washington in the near future to interview Congressmen and Missouri Senators. It is argued importation of Mexican ore is largely responsible for low price of zinc ore here. Matter is to be kept non-political.

Mining Operations on a Larger Scale than customary in this district have been reached by the Waco Mining Co., which is owned by the T. N. Barnsdall Estate interests, of Pittsburgh, Penn., where there are now two concentrating plants in operation in the new Waco-Lawton camp. The newly completed No. 2 mill was recently

started and has a capacity of 450 tons in 10 hours. Steam power and Corliss condensing engines are used. The usual method of concentration in the Joplin district is followed, but jigs, rolls and screens are larger than in ordinary plants. The center drive plan is used in the mill. The sludge department consists of only 10 sand tables, with two additional slime tables. Settling sand tanks are used to furnish feed, but two Dorr thickeners will likely be installed later. This mill is planned to centralize operations at Waco, and a 27-room boarding house, hotel and residences have been built by the company. The No. 1 mill of the Waco Co. is operating steadily with satisfactory results. A third mill will be built this spring just west of the No. 2 mill, and a fourth some distance to the east. The properties lie along the state line, and Nos. 1 and 3 will be in Kansas, while Nos. 2 and 4 will be in Missouri. The company has 350 acres of leased land in the Waco section; also 10,000 acres in leases scattered throughout the district, and in addition, 2600 acres of land owned in fee, situated a short distance southwest of Joplin. P. B. Butler, of Joplin, is manager for the company.

PHOENIX, ARIZ.—Feb. 14

The United Verde Extension Smeltery is lacking the necessary bricks to complete the stack, which will prevent the blowing-in of this plant within the 60 days planned. A good start has been made in the construction of the first furnace, which will be of 800 tons daily capacity. Much of the heavy iron and steel required to complete it is now en route from Pittsburgh. Three converters are to be used to supplement the first furnace. They will probably be completed before the smokestack is ready for use. As soon as furnace No. 1 is finished work will be started on furnace No. 2, which will be a duplicate.

Jerome's Stability as a Producer appears to be well assured. Following the subsidence after the boom, brought by the United Verde Extension, it was expected that a decided drop in activity would follow. Jerome has progressed, however, in the last year to such an extent that despite the erection of a modern hotel and many private houses, the camp is still overcrowded, and it is almost impossible to get accommodations unless these are reserved in advance. The congestion will be partly but not wholly relieved upon completion of the construction of a 46-apartment building, or half a dozen structures containing eight apartments each, by the United Verde Consolidated Copper Co. The building, or buildings, will be fireproof and steam heated and are designed for the accommodation of the employees of the company.

WASHINGTON, D. C.—Feb. 2

Deposits of Potash in This Country were known to exist before the war, notwithstanding that the world's supply of potash practically all came from Germany. Potash deposits on public lands have not been developed heretofore, because all such lands were withdrawn from entry. Under a recent law permits may be issued for exploring potash tracts of land not to exceed 2560 acres. Each permit lasts for two years, and if potash in commercial quality and quantity is discovered, the permittee will be given a patent for one-fourth of the land covered by his permit, and the remainder may be leased by the Government to others. Secretary of the Interior Lane today issued the first prospecting permit under this law, covering 2560 acres of alkaline marsh land in the desert region of Inyo County, California, and the permittee expects to begin explorations promptly by sinking wells.

The Restoration of Coal Lands was announced by Secretary of the Interior Lane, with the approval of the President, for nearly 160,000 acres of withdrawn coal land in northeastern Montana, south of the Missouri River adjacent to the Fort Peck Indian Reservation. The land in this part of the state was withdrawn because reports from various sources indicated that deposits of lignite were present in the area between Missouri and Yellowstone Rivers. Government geologists who have been working in Montana have proved that these lands are for the most part coal land and form a part of the large lignite field in Montana and North Dakota, valuable as a source of lignite. The coal classification work in this part of the country, carried on by the Department of the Interior through the Geological Survey during the last 10 years, has developed the fact that nearly all of the land listed in this order is underlain by one or more beds of lignite. Coal lands adjacent to this area on the north, east and southeast have been classified from time to time and restored to entry and purchase under the coal land laws. A part of the withdrawn land in this section of Montana, namely, 151,429 acres, has been classified as coal land; the remainder, 8511 acres, as non-coal land. The erasure of the withdrawal by the President restored the land to coal entry and makes a large area in this part of the state available to those who wish to open coal mines in order to relieve the shortage of coal. A part of the land was patented prior to the withdrawal and was not affected by the withdrawal or restoration.

TORONTO—Feb. 14

Statement of Silver Ore Shipments over the T. & N. O. Ry. for the month of Jan., 1918, from Cobalt proper were: Aladdin Cobalt, 59.60 tons; Beaver, 39.99; Buffalo, 363.97; Coniagas, 130.50; Dominion Reduction Co., 291.65; Hudson Bay, 32.47; Kerr Lake Mining Co., 29.89; La Rose, 119.18; McKinley-Darragh, 42.11; O'Brien, 129.40; Penn Canadian, 31.43; Right-of-Way, 51.54; Temiskaming, 66.52; Trethewey, 70.35 tons; total, 1,458.60 tons. From Elk Lake, the Miller-Lake-O'Brien shipped 26.10 tons, making a grand total of 1484.70 tons. Nickel ore shipments from Porquis Junction, made from the Alexo mine, were 812.85 tons.

The Mining News

ARIZONA

Cochise County

PEABODY CON. COPPER CO. (Johnson)—Operations in main mine changed from hand to air drills. New machinery installed consists of a 75-horsepower Fairbanks-Morse semi-Diesel-type engine and Sullivan angle compound air compressor

WOLVERINE & ARIZONA (Bisbee)—Old openings near Higgins tunnel shipped in January 100 tons 10% ore, which is almost all profit, as expenses were low; the the Broken Promise claim shipped 1000 tons of 5% ore and openings constantly improved. Ground leased above this claim to be explored for copper and manganese.

Mohave County

GOLD ORE (Oatman)—The crosscut on the seventh level is exceeding the schedule laid out by about 40%, advancing at the rate of nearly 15 ft. daily.

OATMAN UNITED (Oatman)—The drift on the west vein advanced 200 ft. and a winze will be sunk therefrom 200 ft. Plans to sink the main shaft an additional 200 feet.

GOLD RANGE (Oatman)—According to a statement given out by T. T. Torpey, president of the Gold Road Bonanza and Gold Range Development Co., both properties are to be further developed. The work will be under the direction of E. M. Rogers.

Pinal County

BAT CAVE (Kelvin)—Odell and Gross are developing molybdenum ores northeast of Kelvin.

GILA DEVELOPMENT (Kelvin)—The new pumping equipment is working satisfactorily, and drifting is in progress on the 200 level.

TROY ARIZONA (Kelvin)—The crosscut on the 500 level was advanced 150 ft. during January. It has passed out of the diabase into the limestone.

ARIZONA HERCULES (Kelvin)—Mill building is completed and erection of machinery well under way. Central power plant will be in operation this month. Railroad spur at mill practically completed. Add PINAL COUNTY

FORTUNA CONSOLIDATED (Superior)—Report another strike. Tunnel driving on small north and south vein having shipping ore, hoping to reach cross-vein system from Magma and Silver King mines. Tunnel now 900 ft. long.

PEARL (Mammoth)—Detroit people operating the Pearl group formerly belonging to the Tarr interests have purchased the old molybdenum mill at Troy and are moving it to their property four miles from Mammoth.

Yavapai County

ARIZONA BINGHAMTON (Mayer)—Diamond drill on the 600 level is developing an orebody about 40 ft. wide.

BLUE BELL (Mayer)—The Consolidated Arizona company plans to do considerable prospecting by diamond drill from the lower levels this year.

BLUE BELL EXTENSION (Mayer)—New company organized to operate on claims south of the Blue Bell mine. Work in charge of C. J. Murdock.

MONTE DE COBRE (Mayer)—The president of this company, which recently took over the Barbara mine, is W. A. Tucker, of Bisbee. Development work is in progress.

CALIFORNIA

Alpine County

CURTZ (Markleeville)—Large deposit of silver-copper-gold ore reported. Property was optioned last December by William and Edmund Nelson and associates, of Oakland. Three shifts of miners are working. Situation is northeast and near the Cryptic-Carter mine.

Amador County

SOUTH EUREKA-ONEIDA (Sutter Creek)—Reported that properties will be temporarily closed, drainage to be effected by joint pumps of South Eureka and Central Eureka.

OLD EUREKA (Sutter Creek)—Deepening the shaft is progressing at the rate of 17 to 20 ft. a week, three shifts being employed. Expected to deepen 1000 ft. below the present lowest working level of 2100 ft. Clearing out old drifts and crosscuts above the 2000 level also in progress.

KEYSTONE MINES (Sutter Creek)—Semi-annual report to stockholders to Dec. 31, 1917, states that 40-stamp mill crushed 43,151 tons, yielding $7781 in bullion and $107,374 in concentrates. Estimated net profit about $2.10 per ton of ore worked. About 12,000 tons of rock was hoisted from the 1200, 1400, 1800 levels, the 900 level producing 2896 tons and the 1000 level 5636 tons. Large amount of development included opening new level at 2100-ft. point. Will crosscut east and west on this level, prospecting on the west in the Mother Lode slates, which are in evidence on the 2600 level. Other development on the 1800 level. C. R. Downs is manager.

Butte County

WESTERN ORE CO. (Oakland)—Reported to have acquired mineral rights to chrome deposits on the Hendrix and Taylor properties near Lime Saddle north of Oroville. Arrangements being made by A. E. Vandercook, engineer for the company, for installation of concentrating mill. Three large deposits said to have been developed. Concentrate will be hauled by motor truck to Oroville for rail shipment.

Eldorado County

PLACERVILLE REPORTS discoveries of alunite in a gold-bearing quartzite vein three miles south.

Inyo County

SALINE VALLEY SALT CO. (Keeler)—Aërial tramway in operation and shipments being made from the mill by rail. J. A. Goodman, president.

Lassen County

CLARK MINES (Milford)—Reported that copper properties will be developed, which will attract investment for development of other properties in the district.

Nevada County

SIERRA ASBESTOS CO. (Washington)—Permit to issue and sell stock, proceeds to be used in mining and manufacture. John D. Hoff and R. E. Conrad, of Oakland, to receive 600 shares for assignment of purchase option and lease to operate unpatented claims; they to pay the company $200 in addition. Company also authorized to sell to R. E. Leach and Harry E. Leach 400 shares for $25,000 cash. Hoff and Conrad shares to be held in escrow.

ALLISON RANCH (Grass Valley)—Leasers reported to have disclosed a new ledge on No. 3 level. Extends a distance of 30 ft. and is from 6 in. to 3 ft. in width. Mill is operating 15 stamps two shifts on ore mined by leasers, averaging $8 to $10 a ton.

Plumas County

KELLY MINING CORP. (Santa Ana)—Permit to issue 150,000 shares capital stock to H. H. Kelly for purchase option and lease to operate 8 mining claims. Also to sell 50,000 shares at $1 for cash to be used in equipment and development. Kelly shares to be held in escrow.

WALKER COPPER (Portola)—Reported that Anaconda Copper Mining Co. will acquire property. Purchase price said to be about $50,000. New shaft is down below 400-ft. point in large body of ore said to assay 8% copper and $3 per ton gold. Orebody said to have been proven for a length of 900 ft.

San Francisco County

HYDRO-METALLURGICAL CO. (San Francisco)—Permit to issue 37,600 shares capital stock to M. DeKeyser-Verbiest in exchange for process and plant for treating ores, and to sell 12,500 shares at $1, to be used in completion of plant.

Shasta County

KLEINBERG (Redding)—Property situated in Oregon gulch will be Keystone drilled by C. H. Mitchell. If prospecting warrants, the ground will be dredged.

U. S. SMELTING R. & M. (Mammoth)—Has acquired by transfer all the business and property of the Mammoth Copper Mining Co. dating Jan. 1, 1918. Producing three tons of zinc and 200 lb. cadmium per day from Mammoth mines. High-grade zinc ore being developed.

AMERICAN DREDGING CO. (Redding)—Old Reid ferry farm, owned by Mrs. William Menzel, said to have been optioned at a price of $80,000. Farm contains 1042 acres, situated at confluence of Middle Creek and Sacramento River. Ground has been Keystone drilled and was turned down by another company. Early day placer miners found plenty of gold along the river, and the river bed at this point has been dredged and scraped by divers within the last 15 years. Company believes bench lands will pay to dredge.

Siskiyou County

HAZEL (Hornbrook)—Mill started after being idle for four years. Large amount of high-grade ore ready for milling.

COPPER KING (Yreka)—Oregon men said to have optioned this copper property, situated short distance from the Blue Ledge mine.

BLUE LEDGE (Yreka)—Reported that there is prospect of property being optioned by English syndicate operating Ladysmith smeltery at Vancouver. Ore shipments last few months indicate good prospect for development of large copper producer.

CALIFORNIA-OREGON POWER CO. (Hornbrook)—Dedication of Copco dam on Klamath River Feb. 3. The plant has been in operation since Jan. 17. Connecting with the company's general power and lighting system, the Copco plant increases the service to double its former capacity. There are three smaller plants in California and three in Oregon. California points are not now dependent on Rogue River for power.

Tuolumne County

DENSMORE (Columbia)—Reported to be optioned by New York and Denver men. Mine closed about eight years ago on account of death of Alvinza Hayward, owner, and has passed into hands of local men. Developed by 1500-ft. tunnel and equipped with 10-stamp mill.

PACIFIC GOLD MINES CORPORATION (San Francisco)—Deeds have been filed for record at Sonora transferring the Dutch-Sweeney and App properties in Jamestown district. Trust deed of the corporation to the Union Trust Co. of San Francisco for $300,000 bonded indebtedness insures the installation of new milling plant at the Dutch for handling ores of the three mines. To cost about $150,000. W. J. Loring is general manager.

COLORADO

Chaffee County

TURRET COPPER M. AND R. CO. (Turret)—Cut a 9-ft. vein carrying 30 to 40% titanium oxide ore, the important minerals being rutile and ilmenite. High-grade graphite has been discovered in a 7-ft. vein which assays as high as 97% carbon. F. B. Radon is manager.

TURRET INDEPENDENCE (Turret)—Shipping good grade copper ore. R. F. Stratton is lessee.

Lake County

NISI PRIUS (Leadville)—Large shoot manganese ore assaying 35%, opened. Regular shipments made to Minnequah plant, at Pueblo.

BIG FOUR (Leadville)—Leased to M. J. Nicholson. Regular shipments will be made. Vein supposed to be extension of Fanny Rawlings vein.

GRIFFIN (Leadville)—Property in St. Kelvin district. Producing high-grade lead-zinc ore. Power line may be built to mine.

San Juan County

ZUNI (Silverton) — This property, on Anvil Mountain, has been leased to Joe Anderson and Ernest Jackson, who are reopening the mine. The main tunnel is being cleaned out and retimbered. The property once produced high-grade silver ore, but has been idle for many years.

LACKAWANNA (Silverton)—Development work is in progress at the mine, and construction work is being pushed on the new tramway. The company has decided to erect a new mill at the foot of Kendall Mountain, and construction will begin in a few weeks. C. B. Sheahan is superintendent.

San Miguel County

SUFFOLK MILL (Ophir)—Treating ore from Suffolk mine and custom ore from Favorite mine.

CARRUTHERS MILL (Telluride)—Shut down until spring on account of water shortage.

LIBERTY BELL (Telluride)—Mill treating about 500 tons daily. In future plant will be installed to cyanide concentrates.

LEWIS (Telluride) — Mill will now be run full time; previously run half-time. Extraction, especially by flotation, expected to be improved. Crew recently increased.

COLORADO-SUPERIOR (Telluride) — Commonly known as Black Bear, producing about 180 tons daily. Treated at Smuggler mill of Smuggler-Union Mining Co. Ore delivered over aërial tramway.

SMUGGLER-UNION (Telluride)—Smuggler mill running steadily on ore from Smuggler, Humboldt and Black Bear mines. Flotation added to mill and cyanidation eliminated. Old Pandora mill no longer in operation.

Summit County

WELLINGTON (Breckenridge) — Shipments of zinc and lead-silver concentrates being made.

MORE WORK (Montezuma) — Large shoot zinc-carbonate ore opened in development work.

DUNKIN LEASE (Breckenridge)—Lead carbonate ore being mined and stored until roads opened. Mine worked by lessees.

MOLLY B (Breckenridge)—Shipment of hand-sorted bismuth ore returned over $200 per ton. Property one-half mile north of town, on Yuba dam flats.

Teller County

HOLLISTON MINES CO. (Cripple Creek)—Meeting of stockholders to be held to consider proposition to sell all of holdings.

WILD HORSE (Cripple Creek)—Shoot of milling-grade ore opened on 500-ft. level, and shipments resumed. Development work continued on 1250 level.

ENGINEER'S LEASE (Cripple Creek)—Three-year lease taken from Free Coinage Consolidated Mines Co. on Wilson claim. Crosscut being driven into Wilson claim from 800-ft. level of Lee shaft of Isabella workings.

ROOSEVELT TUNNEL (Victor)—Heading beyond eastern boundary of Rose lode claim of Rose Nichol Company, and now within Colorado City lode of Portland Company on northwest slope Battle Mountain. Tunnel now driving southeast toward Portland No. 2 shaft, 1800 ft. When connection is made tunnel will have depth of 2130 ft. below surface, and a total length 26,000 ft. Tunnel cut extension of Hidden Treasure vein in Rose Nichol ground, and a station has been cut for Camp Bird Mining, Leasing and Power Co., which holds 6-yr. lease on Rose Nichol property. Development of Hidden Treasure vein from the Roosevelt Tunnel level will begin at once. T. R. Countryman is consulting engineer for the Roosevelt Tunnel, and Charles Fuller is superintendent.

IDAHO

Shoshone County

MORNING (Mullan) — Management of Federal announces resumption of work at mine Feb. 11. Company employs 600 men in mine and mill, and some difficulty may be experienced in getting full force on account of labor shortage.

AJAX (Burke)—Vein cut in Oom Paul crosscut at depth of 1200 ft., 3 ft. wide and shows more or less galena. Drifting west toward Hercules. Shaft sunk from Moonlight level, 700 ft. above Oom Paul, 200 ft. and crosscut started to vein. Company owns 17 claims and covers the vein for length of four claims, or 6000 feet.

REX CONSOLIDATED (Wallace)—Deal by which new company will absorb the old Rex Mining Co. expected to be consummated in few days. When details closed up work will be resumed at Rex mine. Shaft now down 700 ft. and purpose is to sink 300 ft. further and thoroughly explore ground from that level.

SUCCESS (Wallace)—Strike of lead ore made on the 1500 level. It is 6 or 7 ft. wide and a high-grade milling ore. It has been followed 50 ft. and gives great encouragement. Ground on 1400 level is being prospected with diamond drill. New management has reduced working force almost one-half, and mill is now running only one shift.

JACK WAITE (Murray)—Company expects to resume ore shipments by Mar. 1. Wagon road, including eight bridges, washed out by high water. Repairs now under way. Meantime work in mine suspended. Bins full and much ore broken down ready for shipment. Railroad also washed out, which necessitates hauling ore five miles further until track is restored. Company has substantial surplus and is considering building mill this summer.

MICHIGAN.

Copper

ALLOUEZ (Allouez)—Averaging daily a little over 1900 tons.

HANCOCK (Hancock)—Increasing daily tonnage about 50 tons now to 1150 and will continue increasing.

BEAR LAKE POOL (Calumet)—Sixth hole down 9 ft.; the hole is the southernmost of those drilled.

LA SALLE (Houghton)—Producing ore at the rate of 900 tons daily. Will likely be increased materially this spring.

HANCOCK CONSOLIDATED (Houghton)—Mechanical tramming installed on two levels and is working satisfactorily.

WHITE PINE EXTENSION (White Pine Mine)—Has on 2nd and 4th levels about 5000 ft. of openings in good, uniform ground; employing 50 men.

COPPER RANGE (Houghton) — Tri-Mountain stamp mill, destroyed by fire two years ago, will not be rebuilt this summer, unless the war should be over.

WINONA (Winona) — December's yield in refined copper nearly 15 lb. per ton as compared with 17 lb. per ton for November and 16 lb. for October; January is slightly better.

WOLVERINE (Houghton) — Production at Wolverine gradually is falling off. Decided slump in ore tonnage for last 10 days. Rock is not showing any improvement in quality.

FEDERAL SYNDICATE (Calumet) — Started diamond drill Feb. 10 in Sec. 3-55-34, close to Keweenaw Waterway on strike of beds found mineralized at Bear Lake Pool, 2½ miles northeast.

SENECA (Calumet)—Has cut away the snow and ice to sink shaft. Engine has been turned over; boarding house and shaft house are about ready. Except shallow shaft at extreme north, this is first exploration and it is in most promising ground between Ahmeek and Mohawk; the shaft will be vertical for 2100 ft. and then curving to Kearsarge lode.

CALUMET & HECLA—(Houghton)—Practically all of the big construction plans of the corporation for 1918 will be abandoned and all energy directed to getting out as much copper as possible. This is due to the orders of the Government. Construction of the hospital, for which plans have been completed, may have to be postponed out of deference to the desires of the Government that every effort be directed toward ore output.

MISSOURI

Joplin District

SOUTHERN LEAD AND ZINC (Treece, Kan.)—Pushing work on two shafts and mill building on tract of Cooper land west of Baxter. Charles Neal, Joplin, superintendent.

FREEHOLD OIL AND GAS (Joplin)—Sinking shaft at recently acquired Liberal mine at Waco to 170 ft. to take up 30 ft. stope. New mill almost completed. J. S. Marquiss, Webb City, manager.

BANKERS LEAD AND ZINC (Oklahoma City)—Organized with capital of $250,000 to develop lease at Picher. Mill purchased in Joplin camp will be moved. G. A. Morris, Oklahoma City, secretary.

AMERICAN METAL (New York)—Through its subsidiary, Chanute Spelter Co., has sold lease at Crestline, Kan., to C. R. Strong, trustee, of Clinton, Okla. Mill site is blocked out on land and new owner plans shaft sinking and mill building at once. Mineralization from 60 ft. to 222 feet.

MONTANA

Jefferson County

G. AND B. MINE (Warm Springs)—Denver capital cleaning old 250-ft. shaft to explore property.

AMALGAMATED SILVER MINES (Lump Gulch)—Shaft 230 ft. deep in ore carrying silver.

Lewis and Clark County

HELENA MINE (Helena)—Nine carloads shipped from mine during January.

ROCK ROSE (Helena)—New strike of 2 ft. lead carbonates at 200 level.

BLUE BIRD-HICKEY (Marysville)—Ore from tunnel going to St. Louis Mining and Milling Co.

THOMAS CRUSE DEVELOPING CO. (Helena)—New strike on 640 level showing gold, silver and lead.

SHANNON MINE (Marysville)—Shaft deepened to 650 level. Ore by aërial tram to mill at Gloster.

Meagher County

SMITH MINING AND DEVELOPMENT CO. (Martinsdale)—Consolidation of Black Hawk, Alice and Anne Maud companies. Work to start in spring. The ores are lead-silver and considerable manganese.

Silver Bow County

EAST BUTTE (Butte)—January output was 2,574,140 lb. of copper and 82,175 oz. of silver. This shows steady increase since resumption of Pittsmont smelter operation on Aug. 11.

ANACONDA (Butte)—January output is estimated at approximately 24,900,000 lb. of copper. More than 11,000 tons of copper ore per day are at present being hoisted and about 7000 tons of zinc ore. January zinc production amounted to 4,500,000 pounds.

BUTTE & SUPERIOR (Butte)—January output was 14,600,000 lb. of zinc, showing an increase of 1,200,000 lb. over December output. Silver production for January was 265,000 oz. Total ore mined and treated was 47,000 tons, resulting in 14,600 tons of concentrates, averaging a little under 50% zinc. Recovery in mill was about 94%. The Minerals Separation suit will be heard Mar. 8 by U. S. Circuit Court of Appeals in San Francisco.

NEVADA

Esmeralda County

GOLDFIELD CON. (Goldfield)—Production for December was 19,450 tons of ore, having a net recoverable value of $20,016.24, and 13,848 tons of mill tailings having a net recoverable value of $1660.26. There was 975 ft. of development work performed at a cost of $8.14 per foot. Total operating cost, including marketing, taxes, general expense and royalties, was $8772 per total tons of ore. Miscellaneous earnings amounted to $0.309 per ton and there was no new construction.

Nye County

MANHATTAN RED TOP (Manhattan)—Lateral work being continued. Driving along the fault, which was struck from the 110-ft. level, 184 ft. east from the shaft.

WHITE CAPS EXTENSION (Manhattan)—Lateral work on the 400 level has reached a point 128 ft. east from the station, driving through alternate bands of quartzite and shale. The last 26 ft. in the drift has shown a decided change of formation, stringers of limestone crossing the drift.

UNION AMALGAMATED (Manhattan)—Repairing of the Earl shaft has progressed to the 432-ft. point in the shaft. The past week added 24 ft. Three shifts of shaft timbermen are employed in the work. Everything is in readiness to abandon the old Bath shaft as soon as the Earl shaft is ready.

MANHATTAN CON. (Manhattan)—Shaft to date at depth of 52 ft. below fourth level, with timber sets in place to depth of 42 ft. Three shifts of shaft miners are employed and no other work is being carried on for the present. The water flow is only seepage, which is easily handled by bailing on each shift.

WHITE CAPS (Manhattan)—Resumption of development work from the fifth level west. The drift now out from the station 225 ft. Ore for the mill is being pulled from the third, fourth and fifth levels. Tonnage hoisted approximately 100 tons per day. Although no data yet available as to extraction since the resumption of milling under the new process the mill is working satisfactorily and by next week it will be possible to obtain an estimate of the tonnage treated and the extraction.

OHIO

Lawrence County

IRONTON PORTLAND CEMENT CO. (Ironton)—Potash-recovery plant being installed by W. S. Barstow & Co., 50 Pine St., N. Y. Plant will be capable of handling the dust from 2000 bbl. of cement per day.

UTAH

Carbon County

COAL MINES IN HIAWATHA DISTRICT having the Utah coal route, recently completed as an outlet, are working full time, and during January there was shipped over this route 119,000 tons of coal. The road was able to ship the entire production from the mines.

Juab County

TINTIC SHIPMENTS for week ended Feb. 1 amounted to 196 cars, showing steady increase in last week, having amounted during the two weeks preceding to 141 and 181 cars.

GEMINI (Eureka)—Fourteen months up to Dec. 31, 1917, dividends amounting to $130,000 paid at rate of $26 a share on 5000 shares. During 1917 marketed 489 cars of ore. At stockholders' meeting old directorate reëlected. E. W. Packard, president; Jackson C. McChrystal, manager.

GODIVA (Eureka)—Under same management as Gemini, with practically same directorate. Shipped 22 cars of ore during 1917. Shipments from this property and above held down by car shortage.

Salt Lake County

CONTINUED SHIPMENTS FROM ALTA—The South Hecla. Sells. Michigan-Utah, Alta Con., and Rexall are all shipping. Recent shipments from last-named property amount to 420 tons.

UTAH COPPER (Bingham)—Estimated January output 13,500,000 lb. copper.

EMMA CONSOLIDATED (Alta)—M. M. Johnson, of Salt Lake City, to have charge of operations in place of C. S. Herzig and J. J. Beeson, former having gone to Arizona and latter to take part in the war.

Summit County

PARK CITY SHIPMENTS for the week ended Feb. 1 amounted to 3,748,010 lb. of ore and concentrates.

PARK-UTAH (Park City)—Opening new section in eastern part of camp and interesting developments expected. Working from Ontario drain tunnel. Large amount of ground to be passed through to get to ore.

THREE KINGS (Park City)—In cutting station for pumping equipment a fissure was cut in quartzite. Interesting in view of manner of ore occurrence in neighboring properties, where the intermediate quartzite is associated with orebodies.

Tooele County

DRY CANON—Shippers are principally the Kearsarge, Dry Canon Con. and the Mona, Kidden Treasure, the latter furnishing the largest part of the tonnage. Work is being done at the Utah Queen, Thad Stevens and others.

Uintah County

OIL SHALE LANDS IN UINTAH BASIN, including what is known as the Murdock holdings and covering from 15,000 to 20,000 acres, are to be brought under one control and a company is to be organized to develop the ground. The capitalization of the company to be formed will, it is understood, be $1,000,000. Among those interested with Mr. Murdock are D. K. Gustaveson, petroleum engineer, who has made an examination of the ground; Jesse Knight, William Spry, M. C. Godbe, W. H. Shearman and John Pingree.

ONTARIO

PORCUPINE SHIPMENTS for the week ending Feb. 9 were 10 cars of ore from six mines, and contained a total of 891,279 lbs. of high-grade ore and concentrates. The Mining Corporation also shipped 69,961 oz. of bullion.

DOME LAKE (Porcupine)—Cut good ore at the 500 level.

NIPISSING (Cobalt)—Has taken options on claims in the new district in Powell.

NEWRAY (Porcupine)—Option on property held by Porcupine Crown and Dominion Reduction is expected to be dropped.

MINING CORPORATION (Cobalt)—Has taken option with $25,000 cash payment on a fluorspar property near Madoc, Ontario.

EDWARDS (Porcupine)—Property is being opened with idea of shipping pyrite, of which a considerable quantity exists on property.

HUDSON BAY (Cobalt)—Extensive sampling indicates a large tonnage of low-grade ore capable of being profitably treated.

LA ROSE (Cobalt)—Crosscutting started in the new Violet shaft at 400 ft. depth, where it is expected that one of the O'Brien veins will be cut.

HILL (Munro Township)—Camp buildings have been put up, and a force of 32 men is at work. Shaft is down 70 ft. on a well-mineralized vein.

MOIRA LAKE FLUORSPAR (Madoc)—This mine, owned by Stephen Wellington and G. Munro, has been sold to the Mining Corporation of Canada.

HOLLINGER (Porcupine)—Annual meeting was routine affair and old directors were re-elected. No mention was made of payments of dividends in the future.

OTISSE CLAIMS (Powell Township)—An option has been taken on this property by interests associated with the Dominion Molybdenite Co., of Quyon, Que.

KIRKLAND-PORPHYRY (Kirkland Lake)—No. 1 shaft has reached the 300 level and a 30-ft. sump is being sunk. Vein at 300 shows free gold and tellurides over a width of five feet.

DOME EXTENSION (Porcupine)—Diamond drilling campaign started by the Dome, which had option on this property, is to be continued. Drilling will be done by the Dome Extension.

NIPISSING (Cobalt)—In January produced ore of an estimated net value of $307,019 and shipped bullion from Nipissing and customs ore of estimated net value of $310,881.

WALSH CLAIM (Gowganda)—The Crown Reserve is conducting exploration operations and has installed a plant comprising a 3-drill compressor, hoist and two 40-hp. boilers.

DAVIDSON (Porcupine)—At annual meeting statement was made that ore reserves were 30,000 tons of $15 ore and 10,000 tons of $20 ore. New mill with capacity of 60 tons per day will be in operation next month.

PITTSBURG-LORRAIN (South Lorrain)—Ore from this mine (formerly the Currie) is now being treated by the old mill of the Wettlanger, which has been leased by the company. Crosscutting on the third and fourth levels is under way.

TEMISKAMING (Cobalt)—At the meeting held last week F. L. Culver and associates were defeated and a new board elected, composed of J. P. Bickell, W. J. Sheppard, J. B. Tudhope, and H. D. Symmes, all of the McIntyre board, and W. Linton, G. E. Drummond and G. M. Miller.

TRETHEWEY (Cobalt)—Annual report shows that in 1917 there was 34,722 tons of ore milled, averaging 13.3 oz., of silver per ton, and recovery was 341,278 oz. Net value was $263,017 and operating profit was $114,934. Company is building a plant to treat 66,000 tons of 4.7 oz. tailings. Cost of plant will be $20,000. Reserves are estimated at 264,000 ounces.

PERU

CERRO DE PASCO (Cerro de Pasco)—January production of blister copper was 6,598,000 pounds.

CHOSEN

ORIENTAL CON (Unsan)—November production from 200 stamp mill, operating 28.9 days, crushing 25,882 tons, in gross receipts, $139,409,585; operating costs, $73,637.625; improvements and development, $3,010,225. December clean-up valued at $134,352.81, and for January $125,289. Sufficient native labor is available.

The Market Report

SILVER AND STERLING EXCHANGE

Feb.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Feb.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
14	4.7525	85⅛	42⅜	18	4.7530	85⅛	42⅛
15	4.7525	85⅛	42⅜	19	4.7530	85⅛	42⅛
16	4.7530	85⅛	42⅛	20	4.7530	85⅛	42⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Feb.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
14	*23½	†	7	6.95 @7.00 6.90	7.70 @7.75 7.65
15	*23½	†	7	@6.95 6.90	@7.70 7.65
16	*23½	†	7	@6.95 6.85	@7.70 7.60
18	*23½	†	7	@6.95 6.85	@7.65 7.57½
19	*23½	†	7	@6.90 6.95	@7.62½ 7.55
20	*23½	†	7	@7.00	@7.60

* Price fixed by agreement between American copper producers and the U. S. Government, according to official statement for publication on Friday, September 21, 1917.

† No market.

The above quotations (except as to copper, the price for which has been fixed by agreement between American copper producers and the U. S. Government, wherein there is no free market) are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars.

We quote electrolytic cathodes at 0.05 to 0.10c. below the price of wirebars, cakes and ingots.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17.5c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Feb.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
14	110	110	125	323	320	29½	54
15	110	110	125	323	319	29½	54
16							
18	110	110	125	317	314	29½	54
19	110	110	125	314	311	29½	54
20	110	110	125	313	311	29½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at $4.7515. £29½ = 6.2576c.; £54 = 11.4545c.; £110 = 23.3333c.; £125 = 26.5151c.; £260 = 55.1513c.; £280 = 59.3937c.; £300 = 63.6362c. Variations, £1 = 0.2121205c.

Metal Markets

NEW YORK—Feb. 20, 1918

The most interesting feature of this week was the firmness of lead. The situation in zinc was, if anything, more depressing than it had been previously. With respect to copper, there is nothing new to report.

Copper—The metal is being required by the Government in large quantities. Some settlements are being received from the War Department, which has been tardy in payment. The Navy Department is relatively prompt.

Copper Sheets are quoted at 31½c. per lb., f.o.b. mill, for hot rolled, and 1c. higher for cold rolled. Copper wire is quoted at 26 to 26½c. f.o.b. mill, carload lots.

Tin—There is still no market.

Lead—The Government is taking a good deal. Other business this week was relatively small and spotted in character. There was a fair volume of business in St. Louis, where the price stiffened up, then eased off and today became stiff again.

The quotation on spot lead in London for Jan. 2, 1918, was in error. The correct quotation should have been 29½, in place of 30½, as given, and the monthly average for January should be 29.50.

Zinc—Transactions were light. Some large tonnages were offered at concessions. Several producers desired to sell, but, although they shaded their prices, they found that somebody else had shaded more. At the close the market showed signs of weakness.

President Wilson has approved an agreement reached by the War Industries Board and the producers of Grade A zinc, fixing a maximum price of 12c. a pound f.o.b. East St. Louis, and 12.17c. New York, subject to revision on June 1. A maximum of 14c. a pound for plate zinc and 15c. for sheet, f.o.b. at plants was fixed, subject to the usual trade discount. The following conditions were laid down:

First, that the producers of Grade A, plate and sheet zinc will not reduce the present wages; second, that the Allies, the public and the Government will be sold zinc at the same prices; third, that they will take necessary measures to prevent zinc from falling into the hands of speculators who might increase the price to the public; fourth, that they exert every effort to keep up the production so as to assure an adequate supply during the war.

Other Metals

Aluminum—This market is quiet at 36@38c. per lb. for No. 1 ingots at New York.

Antimony—A little more business than in the previous week was reported. We quote spot at 13⅜c. and futures at 12½@12⅝c., c.i.f., in bond.

Bismuth—Metal of the highest purity for pharmaceutical use is quoted at $3.35 per lb. for wholesale lots—500 lb. and over. The market is quiet.

Cadmium—This metal is quoted at $1.50@1.75 per lb., depending on the quantity.

Nickel—Steady at 50c. per lb., premium of 5c. per lb. for electrolytic.

Quicksilver—Quiet, $115. San Francisco reports, by telegraph, $117.50, steady.

***Cerium Alloy** (safety lamp grade): Round sticks, minimum lot, 11 lb., $40 per lb.; 50-lb. lots, $36 per lb.

***Cerium Iron Alloy:** In rounds and squares, minimum lot 11 lb., $25 per pound.

Gold—A Washington dispatch says gold coin to the amount of $100,000 was withdrawn on Feb. 18 from the Sub-Treasury by a private banking house for shipment to Mexico. It is understood that this is the beginning of an export movement under an arrangement by which the United States Government has agreed to permit the exportation of $7,500,000 to Mexico, a similar amount being retained here to meet the balance of trade created as a result of heavy importations of Mexican silver and hemp into this country.

Silver—The silver market has ruled very steady during the past week, opening at 42⅞d. in London and closing at 42⅜; the demand from London continues large for shipment to London and San Francisco, but offerings of silver have increased of late and sellers are apparently more willing to sell at the market. Shipments abroad have increased, as is shown by the fact that exports from San Francisco for the month of January amounted to 4,433,362 oz. and from New York for the week ended Feb. 16, to 1,301,633 oz.

Mexican dollars at New York: Feb. 14, 68; Feb. 15, 68; Feb. 16, 68; Feb. 18, 68; Feb. 19, 68; Feb. 20, 68.

Platinum—Again a little stronger. We quote $107@109.

Palladium—Firm at $137@138.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 16—(By telegram)—Blende, per ton, high, $68.50; basis 60% Zn. premium, $67.50@62.50; medium to low, $60@50; average, $58.75; calamine, per ton, 40% Zn, $40@35; average selling prices: Blende, $56.71; calamine, $37.61; all zinc ore, $56.11 per ton.

Lead: High, $86.75; basis 80% Pb, $86@85; average selling price, all grades of lead, $79.32 per ton.

Shipments the week: Blende, 6901; calamine, 230; lead, 1525 tons. Value all ores the week, $521,080.

Calamine ores had for several weeks virtually all been purchased by one buyer. The sudden advent of another buyer last week caused an advance of $5 to $7 per ton during the week.

The demand for zinc ores was light, for several reasons: Smelters own most of the ore in bins, shipping conditions for ore and metal are deplorable, and gas smelters report light gas. Spelter, while readily salable, cannot be delivered, one company having a car lost in transit, that no tracer can discover.

Platteville, Wis., Feb. 16—(By telegraph)—Blende, per ton, basis 60% zinc, $61 base for premium grade down to $55 base for second grade. Lead ore, basis 80% lead, $83 per ton. Shipments reported for the week are 1850 tons of zinc ore, 164 tons of lead ore, and 530 tons of sulphur ore. For the year to date the figures are 14,619 tons of zinc ore, 341 tons of lead ore and 3483 tons of sulphur ore. Shipped during the week to separating plants, 3042 tons of zinc ore.

Manganese Ore—Quoted nominally at $1.20 per unit, basis 48%, but a premium is said to have been paid for a large arrival of foreign ore.

Molybdenum Ore—Quoted at $2.10@2.15, basis 85%, but this quotation is only nominal, no business being reported, buyers having withdrawn.

Pyrites—Spanish lump is quoted at 15½c. per unit, on basis of 10s. ocean freight, buyer to pay excess freight and war risk, except that, depending on conditions, concession of 2% of war risk may be allowed. Ocean rates remain at 35s. for Northern and 42s. 6d. for Southern ports. Cargo tonnage is scarce; only half the tonnage required in January was secured.

Tungsten Ore—No transactions in scheelite reported. Quoted nominally at $26. Wolframite is quoted at $20@24, according to grade. There was considerable activity in this ore, especially in impure grades.

***Thorium Ore:** Minimum content thorium dioxide 6%, spot deliveries, carloads and less than carloads, $55 per unit; for 8% ore, minimum lot 1 ton, $80 per unit of ThO_2.

***Uranium Ore:** Uranium oxide minimum 2%, U_3O_8, carloads, $60 per unit per net ton, or $3 per lb. U_3O_8 contained.

***Zirkite:** Carloads, $100 per net ton; less than carloads, $120 per net ton, bags included.

Iron Trade Review

PITTSBURGH—Feb. 19

None of the railroad embargoes has been removed, but as there were somewhat better supplies and a more liberal granting of permits, shipments from the steel mills have increased slightly. A large interest in the Pittsburgh and Valley districts estimates its shipments last week at close to 70% of capacity, against somewhat under 60% of capacity during the week previous. Practically all shippers report some improvement for last week.

The increase in steel shipments is not a measure of the improvement in railroad

*From "Mineral Foote Notes," February, 1918.

*From "Mineral Foote-Notes," February, 1918.

conditions as a whole, for the reason that with the mild weather, of which today completes a fortnight, the railroads have been striving to move loaded cars to destination rather than to move empties, and receipts of freight have greatly exceeded shipments. In due course a more important improvement in the supply of empties is expected. Order C. S. 1 of the car service section of the railroad administration prescribes a sequence of materials that are to be given shipment, in exception to the various embargoes, and the category includes all Government and shipbuilding material, also tinplate, a material that has hitherto been recognized universally, except officially, as a war material. The light supply of box cars will still restrict tinplate movement. None of the railroad embargoes has been removed, and it is possible that embargoes will remain a feature of the situation, essentials being given exception.

The production of pig iron has greatly increased, owing to the movement to the furnaces of a large quantity of coke that was blocked en route. Production of steel has increased only slightly, hardly as much as shipments, since mill warehouses and yards were full of finished product, and pig iron is now accumulating. The production of steel now depends upon the shipment of finished product, rather than upon the supply of pig iron, which, although below normal, is ample in the circumstances for the immediate needs of most steel interests.

Demand for steel has been absolutely stagnant for weeks past, but is beginning to show slight signs of revival in a few quarters, particularly in the case of the automobile trade, which reports better sales at the recent shows than had been expected.

There is not much discussion of the price revision that is in prospect by reason of the set prices having been extended to Mar. 31. Some fears are entertained that Washington will desire a downward revision, and this is objected to on account of the high costs lately resulting from irregular operation. The situation should be made clearer soon by the gradual resumption of freight movement in volume, whereby there will be a test of how much commercial demand there really is for steel. It seems well established that war requirements, particularly with the slow work at shipyards and in some other directions, cannot require more than about half the tonnage the steel industry is capable of producing if permitted by transportation conditions to operate at capacity.

Pig Iron—All the merchant furnaces are behind in pig-iron deliveries, chiefly through light production, but in some cases through embargoes. In one sense there is no prompt iron whatever really available, but furnaces are making occasional carload sales for prompt shipment, to take care of pressing needs of customers. There is a moderate amount of business being done in foundry iron for the second half of the year, but no interest in bessemer or basic for that delivery. The set prices rule as the market: Bessemer, $36.30; foundry and basic, $33; malleable, $33.50; gray forge, $32, f.o.b. furnace, freight from Valley furnaces to Pittsburgh being 95 cents.

Steel—There is a little inquiry for soft steel billets and sheet bars, but the recognized absence of offerings discourages consumers from inquiry. There is a fair inquiry for shell-steel discards, but shipment is difficult on account of the embargo. Ordinary discard steel is held at a shade under the corresponding set prices for soft steel. Some discard steel is being shipped and sold as forging steel, at the full forging-steel prices or a shade less. Soft steel remains quotable at the set prices: Billets, $47.50; small billets, $51; slabs, $50; sheet bars, $51; rods, $57.

Ferroalloys

Ferromanganese—The recognized market quotation remains $250, delivered, for prompt or forward. Carloads usually bring this price, but inquiries running into hundreds of tons usually bring out prices $2 to $3 a ton less.

Coke

Connellsville—Shipments of Connellsville coke have been increasing slowly, and even this week are likely to fall far short of regular requirements, but owing to the clearing of much of the railroad congestion in the last 10 days, a great deal of coke that was en route has reached furnaces, giving most of them a full supply, and in some cases an excess that can be unloaded only with difficulty. The return of empties promises to be rather slow. Practically no free coke reaches the open market. Set prices remain at $6 for furnace and $7 per ton for 72-hour foundry, selected.

STOCK QUOTATIONS

N. Y. EXCH.†	Feb. 19
Alaska Gold M	2⅛
Alaska Juneau	2⅜
Am.Sm.& Ref.,com.	85⅜
Am. Sm. & Ref., pf.	105¼
Am. Sm. Sec., pf., A	93
Am. Zinc	16½
Am. Zinc, pf	47
Anaconda	65⅝
Batopilas Min	1
Bethlehem Steel	83
Bethlehem Steel, pf.	90
Butte & Superior	20½
Butte Cop. & Zinc	10½
Cerro de Pasco	33
Chile Cop	17
Chino	45
Colo.Fuel & Iron	41½
Crucible Steel	66½
Crucible Steel, pf	89½
Dome Mines	9⅛
Federal M. & S.	13
Federal M. & S., pf.	36½
Great Nor., ore ctf.	29⅝
Greene Cananea	42
Gulf States Steel	95
Homestake	82
Inspiration Con	48
International Nickel	28⅜
Kennecott	34
Lackawanna Steel	80
Mexican Petrol	93½
Miami Copper	32½
Nat'l Lead, com.	55½
National Lead, pf	100
Nev. Consol	19½
Ontario Min	5
Ray Con	24⅛
Republic I.& S.,com.	80⅜
Republic I. & S., pf.	99½
Sloss-Sheffield	52⅝
Tennessee C. & C.	16⅛
U. S. Steel, com	97⅛
U. S. Steel, pf	111½
Utah Copper	84⅜
Va. Iron C. & C.	66

N. Y. CURB†	Feb. 19
Big Ledge	1⅛
Butte & N. Y.	3/16
Butte Detroit	3/16
Caledonia	.50
Calumet & Jerome	1⅛
Can. Cop. Corpn	2
Carlisle	‡2
Cashboy	.09½
Con. Ariz. Sm.	2⅛
Con. Coppermines	5⅛
Con. Nev.-Utah	‡⅛
Emma Con	3/16
First Nat. Cop.	2⅛
Goldfield Con	.40½
Goldfield Merger	.04
Greenmonster	.75
Hecla Min	3 13/16
Howe Sound	‡4
Jerome Verde	1/16
Kerr Lake	5⅛
Louisiana	.50
Magma	41
Majestic	28
Marsh	.04½
McKinley-Dar-Sa	.53
Milford	‡.75
Mohican	25
Mother Lode	26
N. Y. & Hond	‡11½
Nipissing Mines	8⅛
Nixon Nevada	1 1/16
Ohio Cop	1/16
Rawley	2⅛
Ray Hercules	4⅛
Richmond	‡.56
Rochester Mines	.34
St. Joseph Lead	16⅝
Standard S. L.	40⅜
Stewart	.25
Success	.10
Tonopah	3⅞
Tonopah Ex	1⅛
Tribullion	1/16
Troy Arizona	.11
United Cop	.50
United Verde Ext	.41
United Zinc	1⅞
Utica Mines	‡.08

SAN FRAN.*	Feb. 19
Alta	.04
Andes	.14
Best & Belcher	.01
Caledonia	.05
Challenge Con	.04
Confidence	.08
Con. Virginia	.13
Gould & Curry	.01
Hale & Norcross	.01
Jacket-Cr. Pt.	.06
Mexican	.09
Occidental	‡.60
Ophir	.12
Overman	.01
Savage	‡.01
Sierra Nevada	.08
Union Con	1.15
Utah Con	‡.01
Belmont	3.20
Jim Butler	.58
MacNamara	.14
Midway	.08
Mont.-Tonopah	.11
North Star	.05
Rescue Eula	.09
West End Con	.71
Atlanta	.10
Booth	.03
Comb. Frac	‡.02
D'field Daisy	‡.02
Florence	.15
Jumbo Extension	.15
Kewanas	.07
Nevada Hills	‡.04
Nevada Packard	.20
Round Mountain	.24
Silver Pick	.04
White Caps	.64
Big Jim	‡.75
United Eastern	4.50

BOSTON EXCH.*	Feb. 19
Adventure	1¼
Ahmeek	80
Algomah	.20
Allouez	52
Ariz. Com., ctfs	13¾
Arnold	.20
Bonanza	.15
Butte-Balaklava	.28
Calumet & Ariz	69
Calumet & Hecla	450
Centennial	14½
Copper Range	47⅛
Daly West	1⅝
Davis-Daly	5⅛
East Butte	10
Franklin	5⅜
Granby	76
Hancock	9
Hedley	‡13
Helvetia	25
Indiana	85
Isle Royale	22
Keweenaw	1⅛
Lake	6
La Salle	2⅜
Mason Valley	5⅛
Mass	6⅛
Mayflower	1
Michigan	2
Mohawk	63¼
New Arcadian	2
New Idria	13
North Butte	15⅝
North Lake	.35
Ojibway	1
Old Dominion	43½
Osceola	60
Quincy	75½
St. Mary's M. L.	54
Santa Fe	.75
Seneca	8
Shannon	5⅛
Shattuck-Ariz.	17
So. Lake	1⅛
So. Utah	.14
Superior	4⅛
Superior & Bost.	3
Trinity	3⅞
Tuolumne	.99
U. S. Smelting	.49
U. S. Smelt'g, pf.	45½
Utah Apex	2⅛
Utah Con	11½
Utah Metal	2⅛
Victoria	2½
Winona	1¼
Wolverine	35
Wyandot	.60

BOSTON CURB*	Feb. 19
Alaska Mines Corp.	.20
Bingham Mines	8⅜
Boston Ely	.70
Boston & Mont.	.49
Butte & Lon'n Dev.	.12
Calaveras	1
Calumet-Corbin	‡.01
Chief Con	2⅜
Cortez	.10
Crown Reserve	.22
Crystal Cop.	.74
Eagle & Blue Bell	2
Gila Copper	17
Houghton Copper	.75
Intermountain	‡.70
Iron Cap, Com	19⅜
Mexican Metals	.54
Mines of America	1½
Mojave Tungsten	.05
Nat. Zinc & Lead	.30
Nevada-Douglas	.95
New Baltic	.90
New Cornelia	16⅛
Oneco	.20
Pacific Mines	‡.35
Rex Cons	.05
Yukon Gold	1⅞

SALT LAKE*	Feb. 16
Bannack	‡.26
Cardiff	2.50
Colorado Mining	.08
Daly	1.45
Daly-Judge	6.25
Empire Copper	‡1.10
Gold Chain	.08
Grand Central	.57
Iron Blossom	.43
Lower Mammoth	‡.03
May Day	.02
Moscow	‡.02
Prince Con	.58
Rico Wellington	.17
Silver-King Coal'n	2.67
Silver King Con	2.50
Sioux Con	.02
So. Hecla	.80
Tintic Standard	‡1.35
Uncle Sam	‡.01
Walker Cop	1.70
Wilbert	.10
Yankee	.02

TORONTO*	Feb. 16
Adanac	.08
Bailey	‡.05
Beaver Con	.24
Chambers Ferland	.09
Conlagas	3.10
Hargraves	.06
La Rose	.32
Peterson Lake	.08
Temiskaming	.29
Wettlaufer-Lor	.04
Davidson	.34
Dome Exten	.09
Dome Lake	.22
Hollinger	4.90
McIntyre	1.38
Newray	.24
Porcu. Crown	.20
Teck-Hughes	.49
Vipond	.24
West Dome	.12

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Feb. 19
Cresson Con	4.93¾
Doctor Jack Pot	.04
Elkton Con	.05½
El Paso	.15
Gold Sovereign	.02½
Golden Cycle	1.77
Granite	.41
Isabella	.07
Mary McKinney	.06½
Portland	1.10½
United Gold M	15⅜
Vindicator	.35

LONDON	Jan. 29		
Alaska G. F.	£0	10s	6d
Burma Corp.	4	2	6
Cam & Motor	0	12	3
Camp Bird	0	8	0
E' Oro	0	9	3
Esperanza	0	8	9
Mexican Mines	5	12	6
Min. Corp. Can.	0	15	9
Nechi, pfd.	0	9	9
Oroville	0	18	6
Santa Gert'dis.	0	13	9
Tomboy	0	19	9

* Bid prices. † Closing prices. ‡ Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1916	1917	1918	1916	1917	1918
Jan.	56.775	75.630	88.702	26.960	36.682	44.356
Feb.	56.755	77.585		26.975	37.742	
Mar.	57.935	73.861		27.597	36.410	
April	64.415	73.875		30.662	36.963	
May	74.269	74.745		35.477	37.940	
June	65.024	76.971		31.060	39.065	
July	62.940	79.010		30.000	40.110	
Aug.	66.083	85.407		31.498	43.418	
Sept.	68.515	100.740		32.584	50.920	
Oct.	67.855	87.332		32.361	44.324	
Nov.	71.604	85.891		34.192	43.584	
Dec.	75.765	85.960		36.410	43.052	
Year	65.661	81.417		31.315	40.851	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1917	1918	1917	1918	1917	1918
Jan.	28.673	23.500	131.921	110.000	142.895	125.000
Feb.	31.750		137.895		148.100	
Mar.	31.481		136.750		151.000	
April	27.935		133.842		147.158	
May	28.788		130.000		142.000	
June	29.962		130.000		142.000	
July	26.620		128.409		140.409	
Aug.	25.380		122.391		137.000	
Sept.	25.073		117.500		135.250	
Oct.	23.500		110.000		125.000	
Nov.	23.500		110.000		125.000	
Dec.	23.500		110.000		125.000	
Year	27.180		124.892		138.401	

Tin	New York		London	
	1917	1918	1917	1918
January	44.175	(a)	185.813	293.227
February	51.420		198.974	
March	54.388		207.443	
April	55.910		220.171	
May	63.173		245.114	
June	62.053		242.083	
July	62.570		242.181	
August	62.681		243.978	
September	61.542		244.038	
October	61.851		247.467	
November	74.740		274.943	
December	87.120		298.556	
Av. year	61.802		237.563	

(a) No average computed.

Lead	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	7.626	6.782	7.530	6.684	30.500	29.50
February	8.636		8.595		30.500	
March	9.199		9.120		30.500	
April	9.288		9.158		30.500	
May	10.207		10.202		30.500	
June	11.171		11.123		30.500	
July	10.710		10.644		30.500	
August	10.594		10.518		30.500	
September	8.680		8.611		30.500	
October	6.710		6.650		30.500	
November	6.249		6.187		30.500	
December	6.375		6.312		30.500	
Year	8.787		8.721		30.500	

Spelter	New York		St. Louis		London	
	1917	1918	1917	1918	1917	1918
January	9.619	7.836	9.449	7.661	48.329	54.000
February	10.045		9.875		47.000	
March	10.300		10.130		47.000	
April	9.459		9.289		54.632	
May	9.362		9.192		54.000	
June	9.371		9.201		54.000	
July	8.643		8.473		54.000	
August	8.360		8.190		54.000	
September	8.136		7.966		54.000	
October	7.983		7.813		54.000	
November	7.847		7.672		54.000	
December	7.685		7.510		54.000	
Year	8.901		8.813		52.413	

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Pig Iron, Pgh.	Bessemer‡		Basic‡		No. 2 Foundry	
	1917	1918	1917	1918	1917	1918
January	$35.95	$37.25	$30.95	$33.95	$30.95	$33.95
February	36.37		30.95		30.95	
March	37.37		33.49		35.91	
April	42.23		38.90		40.06	
May	46.94		42.84		43.60	
June	54.22		50.05		50.14	
July	57.45		53.80		53.95	
August	54.17		50.37		53.95	
September	46.40		42.24		48.58	
October	37.25		33.95		33.95	
November	37.25		33.95		33.95	
December	37.25		33.95		33.95	
Year	$43.57		$39.62		$40.83	

‡ As reported by W. P. Snyder & Co.